UNIT 1 - SPRING, 1989, OUTAGE
ENGINEERING INSPECTION REPORT

STEAM GENERATOR - BURNER INSPECTION

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OBSERVATIONS AND WORK ACCOMPLISHED

Babcock and Wilcox (B&W) had contractual work responsibilities to continue to resolve outstanding problems experienced with the operation and maintenance of the burners and their related components. IPSC's Engineering Services inspected the burners to document condition, monitored the repair activities, plus tested the burners after the outage to ensure adequate burner operation, flame stability and burner register mobility.

The boiler platform was utilized during the extended outage to inspect the burner fronts from the fireside which proved to be of valuable assistance, in conjunction with the inspections conducted from the windbox. Sahn Tram, B&W Field Service Engineer, assisted with most of the burner inspections. Problems and status with the burners will also be discussed in his final boiler inspection report. Outage activities completed by B&W and IPSC Maintenance and the inspection observations made on the burners are listed below:

CONICAL COAL DIFFUSERS - The conical coal diffusers (located internal to the burner nozzle which provides dispersion of coal around the perimeter of the burner for uniform combustion) were inspected very closely for the first time during this outage. The boiler platform was used to make the fireside inspections for determining the extent of erosion and wear to the coal diffusers.

Extensive wear was found on several of the upper vertical struts which hold the conical diffuser to the outer shroud assembly. Burners 1A04 and 1A06 were the worst and had their diffuser assemblies replaced (reference Photos 1 through 3). Wear greater than 50% through the bracket was recommended for replacement. Dimensions were 3 1/2 and 4 1/2 inches respectively of metal remaining on the upper struts as compared to 8 1/2 inches when diffuser assembly is new (see Photo 4).

In addition, the conical coal diffuser for 1C06 burner was replaced due to cracking. 1A05's diffuser assembly was also replaced due to cracking from a previous on-line burner line fire.

PLASMA TORCH IGNITION SYSTEM - B&W Construction removed the plasma torch ignition system on Unit 1's bottom row burners, (Pulverizers 1B - front wall and 1G - rear wall), per contractual negotiations. This eliminates this system entirely from functional use. All related components and peripheral equipment to this system are thus disabled.

PLASMA TORCH CONICAL DIFFUSERS - The plasma torch ignition system was removed during this outage, but alterations did not include removal of the plasma torch style coal diffusers and replacement with the standard conical diffuser design.

Inspections conducted on the bottom row burners showed extreme signs of wear to the plasma torch sleeves, PT - stye diffusers and U-bracket end supports. Reference Photos 5 through 10. B&W did repair the U-bracket supports which hold the end of the plasma torch sleeve to the outer end of the nozzle. In most cases, the U-bracket supports were worn so severe that only 1/2 to 1/8 inch of metal was remaining, plus on two of the twelve burners, the brackets were completely missing. B&W did not repair nor replace the plasma torch sleeves or diffusers.

It was determined by B&W that these items were routine wear and replacement parts should be replaced as required by IPSC during the next available maintenance outage. These alterations pertain to Unit 1 Burner Rows 1B and 1G only.

HD OUTER REGISTERS - Photos 11 through 13 show the HD outer register assembly overheat and thermal expansion damage and concerns. The HD outer registers are installed on the upper row burners, Pulverizers 1E (front wall) and 1D (rear wall). These are the only burner rows on either unit which have the modified outer register assemblies installed. The new HD assemblies have an improved style linkage mechanism for the outer register vanes which prevents most of the previous linkage binding.

The outer air register assembly, back (rear) plate on the HD registers has sheared off its retaining bolts due to thermal expansion. Permanent swelling on the inner perimeter of the register assembly prevents rebolting these sections back together.

This overheating condition is occurring although burner front operating and out-of-service temperatures are monitored and maintained below B&W's maximum allowable temperatures (1350 degrees F) for the stainless steel register assemblies.

BURNER OVERHEAT - Inspections indicate overheating and thermal expansion is an ongoing problem with the burners and their components which is steadily getting worse. Permanent warping, rippling, barreling, discoloration, flaking and thermal expansion damage is being observed on the HD and standard outer register assemblies, register vanes, drive handles, throat sleeves, inner air sleeves, casing rings, lighter shrouds and lighters (reference Photos 14 through 25 which document these conditions).

Again note, damage is occurring even though B&W operating procedures and instruction are being followed. Cooling air requirements for maintaining the burner front temperatures are being operated below B&W's limitation of 1350 degrees F.

BURNER NOZZLE 1A05 - Coal burner 1A05 had a previous detected on-line burner line fire which had been isolated from the other five burner lines prior to the beginning of the outage. Maintenance removed the coal pipe elbow for inspection of the diffuser and coal nozzle. The coal diffuser had been damaged due to the overheat condition of the fire and was replaced with the nozzle in-place. The coal nozzle pipe was inspected and determined not to have suffered sufficient damage to effect its structural integrity.

BURNER 1C04 CASING RING - During the windbox inspections, Burner 1C04 was found with the throat sleeve casing ring almost completely dropped out due to the attachment welds failing (reference Photos 27 through 29). This casing ring helps provide a seal for the outer air register assembly and throat sleeve to the waterwall front. The seal ring is intended to be packed with rope packing to provide an air tight seal. Maintenance reattached and repaired Burner 1C04's throat sleeve casing ring in its proper position (see Photo 30).

Based on examinations, broken welds are fairly common on this casing ring on all 48 of the burners. B&W Field Service noted these were not burner structural welds and that an air tight seal was not required for proper burner operation. The remaining burners were checked, but did not have the throat sleeve casing ring attachment welds repaired. See Throat Sleeve Casing Ring heading for additional information and recommendations.

THROAT SLEEVE CASING RING SEAL - The throat sleeve casing ring which is to provide an air tight seal between the outer air register and the throat sleeve assembly to the waterwall is in a greatly deteriorated condition.

There are broken welds and warping of the casing ring which has caused excessive gaps to develop between the throat sleeve and waterwall. Roper packing which is to provide the air tight seal is 90% nonexistent.

This seal is to prevent air leakage from bypassing combustion (secondary) air flow from out around the outside of the burner. It also provides a seal to prevent fly ash, coal and fuel oil from being reentrained (licked-back) back into the windbox (reference Photos 31 and 44).

B&W stated and has held in the past that they do not feel that this is a serious item of concern and that it does not pose an operational problem.

Engineering Services feels that this seal is far more critical for effective combustion and control and for maintaining oxygen tuning and balancing requirements. IPSC feels that this has been demonstrated utilizing the oxygen profile analysis.

OUTER REGISTER ASSEMBLY THERMAL EXPANSION - The outer air register was modified during a previous outage so that it was free floating (retained by clips) which allowed movement to prevent thermal expansion structure damage. Since this modification which initially had minor clearances, the inner air sleeve has moved to the point where clearances in some areas are greater than one inch (reference Photos 45 and 46). This thermal expansion problem causes additional air leakage around the air sleeve and backplate of the outer air register assembly. Note that this air is still in the outer air register zone.

INNER AIR SLEEVE ASH DEPOSITS - Photos 47 through 51 show deposits which have settled out on the outer tip of the inner air sleeve directly below the coal line nozzle. This ash consistency varies from fly ash (powdery) to slag and molten coal. How and why these deposits accumulate on the inner air sleeve is unknown. Also to what degree these deposits effect inner (spin) air flow distribution and their effect on performance in uncertain.

LIGHTERS - Lighters were found to be in extremely dirty condition with fouling and coking very evident. Overheat conditions were also noted with several of the lighter end shields swelling or barreling due to overheating. Two of these assemblies were replaced (Burners 1C03 and 1F04) due to significant damage.

Seven lighters had leaky fuel oil isolation valves which pose a fire potential and safety concern. All identified leaky valves were repaired (reference Photos 52 through 57).

LIGHTER SHROUDS - All lighter shrouds were inspected and found to be in-place. The origin of the lighter shroud recovered from the bottom ash clinker grinder by Operations could not be determined. If may possibly have come from Unit 2.

Several U-straps which hold the shroud in place against the inner air sleeve were broken due to overheating and warpage. Severe warpage of the inner air sleeve that was observed, can be attributed to overheating at the lighter shroud attachment at the outer end of the coal nozzle. This attachment weld prevents the shroud from sliding back horizontally which would allow it to fall forward out of the front U-bracket support, which has occurred in the past (reference Photos 58 through 60).

SCANNERS - Buckshot damage was found on one scanner casing due to eyebrows and clinkers on the furnace waterwalls being shot off to help prevent personal injury from falling objects during outage activities (reference Photos 61 and 62).

Grounds found on the scanner flame detection system were identified and traced out to eliminate operational problems with the scanners. A significant problem has been occurring in the past with scanners detecting flames without the burner row being inserted.

BURNER THERMOCOUPLES - Instrumentation for temperature measurement on the burner fronts were upgraded so that each burner has two thermocouples (reference Photo 11). One thermocouple was attached to the outer register backplate and the other to the coal nozzle tip (see enclosed drawings). Previously, every other burner had four thermocouples installed, but did not provide sufficient temperature measurement required of all burners.

The thermocouple addition was necessary for monitoring cooling air flow requirements to all out-of-service burners to prevent overheat conditions on an individual burner basis. Additional temperature indication will also help detection of burner line coal fires for the prevention of major equipment damage to coal nozzle, ceramic line elbow, diffuser, deflector and other burner related equipment.

OUTER REGISTER SLIP JOINT DRIVE RODS - The outer register adjustment drive rod arms were identified during a previous outage as having thermal expansion and bowing problems restricting their on-line mobility. A slip joint modification was installed by B&W on all of the outer register drive rods which allows thermal expansion to occur, but is taken up by the slip joint. This avoids the effects of thermal expansion which has been causing gear misalignment and linkage binding.

OUTER REGISTER AUXILIARY DRIVE HANDLES - The heavy duty auxiliary outer register drive arm handles were removed by B&W on all burners previously equipped with this modification. The auxiliary drive handles were determined not to have been effective in providing enhanced outer register mobility.

SPIN VANE GEAR ASSEMBLIES - Spin vane drive gear assemblies had fly ash accumulation between the gear teeth preventing adjustment of the inner air registers which is necessary for tuning and improving flame stability and quality. This ash accumulation was scraped and wire brushed off during the outage.

WINDBOX FLY ASH ACCUMULATION - Large amounts of fly ash accumulation has been found in the bottom of the first and third burner levels mainly between the third and fourth burners. Depths of up to 16 inches were vacuumed out during the outage.

BURNER FRONT GENERAL STATUS - Photos 63 through 66 show overall burner front views taken from the fireside of the boiler platform to document general status and condition of the burners. The front wall boiler platform is shown in Photo 65. The platforms were extremely useful for the burner front inspections and for determining diffuser wear and other problems. Why the ash accumulation in these areas and not in the other windboxes is unknown.

BURNER AIR REGISTER POSITIONS - Burner outer and inner (spin) register and back plate positions were documented immediately following the start of the outage for baseline information. These positions were reviewed by B&W and revised settings were determined to set registers prior to the completion of the outage.

The burner register setups were identical to those made during Unit 2's outage. Attached is a copy of B&W's Unit 2 memorandum documenting the final burner register positions. All previous register marking indications were painted over and new baseline reference markings were made.

BURNER PERFORMANCE TESTING - Burner turndown testing was scheduled after the unit was returned to service to verify burner flame quality and stability from minimum to maximum coal feed rates. Oxygen profiles are scheduled to be conducted by B&W and IPSC to complete tuning requirements of the combustion system.

RECOMMENDATIONS

BURNER INSPECTION/THIRD PARTY CONSULTANT - Due to the findings on Unit 1 with the overheating concerns on the burners, a third party boiler/burner expert should be utilized to make recommendations for future repair on the burners.

An independent analysis would be useful in approaching B&W on resolving overheat conditions, plus addressing other issues on the burners. Recommendations should consider; determination of remaining life, estimation on cost of repairs, time schedule if major repairs are required, recommendations on cooling air requirements and burner front temperature limits, additional instrumentation and control requirements and impact on boiler performance and its effect on unit heat rate.

Potential burner experts include; Bill Newkirk, B&W retiree who was involved in the original design and addressing the initial problems with the burners, RJM Corporation who specializes in burners and combustion modeling and tuning, plus any number of companies specializing in Boiler Life Extension.

BURNER INSPECTION/BOILER PLATFORM - The burner fronts should be inspected from the fireside of the boiler on an annual basis to identify potential burner problems. The small rear wall, three man platform should be used to assist with these inspections.

Unit 2 should be inspected at the earliest opportunity to determine general status of the burners. It has not yet had a boiler fireside inspection conducted on the burners.

CONICAL COAL DIFFUSERS - A replacement or refurbishment schedule needs to be established for the conical coal diffusers either based on burner front inspections (off the fireside boiler platform) or by systematic assignment.

Possible loss of a conical coal diffuser due to erosion, wear or cracking of the holding brackets or struts should justify thorough inspection during each available outage. Unit 2 has not yet had a burner front and diffuser inspection. Diffuser loss from inside the burner would result in increased coal flow to that burner due to loss of coal nozzle restriction compounding problems, plus starving flow to the other burners. Extremely poor flame quality or possible loss of flame and potential carbon carry over into the backpass areas would pose a fire explosion hazard.

Investigate hardened alloy or ceramic overlay material around the vertical struts to the diffusers to lengthen life and speed repair of the diffuser assemblies. Install wear clips on all existing, plus all new assemblies (before installation) to prolong wear life.

In addition, investigate repositioning coal deflectors on the burner coal nozzle to prevent concentrated wear on the upper struts of the diffusers that have shown accelerated erosion.

The bottom row diffusers on both front and rear wall burners require replacement to standard diffusers (Pulverizers 1B and 1G) due to plasma torch ignition system removal (16 total). Reference heading on the Plasma Torch Conical Diffusers.

Adequate replacement parts and materials need to be on hand for diffuser replacement or refurbishing on both units. These include diffuser assemblies, replacement cones, brackets, deflectors, wear clips, ceramic patch materials (for coal pipe elbow repair), gasket materials, etc.

PLASMA TORCH CONICAL DIFFUSERS - All 12 lower row burner coal diffusers (Pulverizers 1B and 1G) need replacement due to severe erosion. Return diffusers back to the standard design conical coal diffusers (solid type) from the present plasma torch hollow style.

This process involves removal of the ceramic lined elbows and permanently removing the ceramic lined plasma torch sleeves which are attached inside the elbow. The hollow conical diffusers and U-bracket support attachment at the end of the nozzle needs to be removed. The PT-style diffuser needs to be replaced with the standard conical coal design, noting any differences between the two designs.

Any ceramic repairs required on the coal line elbows when the sleeves are removed needs to be made. Also, a steel blank off plate should be bolted over the test tap on the elbow.

PLASMA TORCH SPARE PARTS - All plasma torch ignition system spare parts in the warehouse inventory should be exchanged with B&W for standard issue wear items on the burners or for reimbursement.

Some of these parts include the coal nozzle diffusers. The plasma torch style diffuser which is of hollow design should be exchanged or modified by B&W to a solid conical style diffuser.

PLASMA TORCH IGNITION SYSTEM - The additional plasma torch ignition system related components other than just the power supply cabinets should be checked out and removed if determined a potential threat to unit availability.

The primary concern involves the Bailey Control logic and wiring to the boiler combustion control system which interfaced with the plasma torch ignition system. This should be removed to eliminate any potential logic or grounding problems from occurring in the future. The plasma torch ignition system was installed on Unit 1 burner rows B and 1G only.

HD OUTER REGISTERS - The overheat and thermal expansion problems on the HD outer register assemblies should be considered a contractual issue with B&W and negotiated with them for resolution. Some type of retaining attachment, in the interim, needs to be added to the backplate to prevent structural failure of the outer register assembly.

Dropping burner front temperature limits to 1200 degrees F on the out-of-service burners would significantly help prevent additional damage from occurring. This item needs to be addressed with B&W due to the adverse impact on reducing boiler efficiency plus, making it more difficult to obtain superheat temperatures with an upper row pulverizer out-of-service.

BURNER OVERHEAT - The burner overheating and thermal expansion damage should be considered a contract deficiency item with B&W and left to them for resolution.

Reducing cooling air flow requirements from 1350 degrees F to 1200 degrees F to out-of-service burners, should reduce further damage from occurring. Again note; increasing air flow requirements for out-of-service burners will significantly impact boiler performance. Increasing cooling air on the top level burners especially at the lower load operation with multiple burner levels out-of-service greatly increases overall secondary air flow requirements for cooling air demand, thus greatly increasing excess air and dry gas losses.

Resolution should be sought from B&W for any changes to burner front temperature limitation, so that compensation for any performance degradation resulting from these temperature changes can be adequately addressed. Also, a final excess air versus firing rate curve is required from B&W to establish final cooling air flow requirements against the number of pulverizers out-of-service.

THROAT SLEEVE CASING RINGS AND SEAL - This item should be taken up with B&W as a long term continuing contractual warranty deficiency item and put to them for final resolution and repair.

All throat sleeve casing rings should be reattached where there are any broken welds to prevent a failure similar to that on Burner 1C04. Reference Burner 1C04 Throat Ring Casing heading under Observations and Work Accomplished.

An air tight seal should be reestablished either with the original design utilizing rope packing or with an equivalent design such as a leaf spring type seal. This seal is to prevent secondary air from bypassing the burner and combustion zone and entering as casing air leakage which has adverse effects on combustion tuning and balancing.

The overheat problem on the throat sleeve casing ring could be improved by lowering the burner front temperatures on out-of-service burners. Note; previous stated concerns on lowering temperatures and their impact on boiler performance.

REGISTER HANDLES - Modify outer and inner (spin) register handles to prevent handles form vibrating and working loose form their preset positions. This problem has been attributed to several burner and scanner alarms for poor flame quality or complete lose of flames. Build up tip of handle locking latch (with a weld bead) to provide a more positive anchoring point. This item is a safety issue since it has the potential of causing flame instability and flame out condition which could lead to a possible boiler explosion.

Drill out register handles to allow installation of a paddle lock to prevent tampering of preset register positions. Order and install locks with a common key (Unit 2 already has this modification completed only on the outer register handles).

Check all hexagon set screws on the register drive handles to verify they are functional. There has been a problem in the past with these screws working out (due to vibration from the pulverizers) allowing the register handles to move. Also, some of these screw holes have been stripped or the set screws are bound or locked up. Drill and retap those screws that have problems so that all registers are functional for future combustion tuning requirements.

OUTER REGISTER MECHANICAL STOPS - The outer register drive assemblies need mechanical stops installed. This will prevent over stroking of the register damper linkage which causes immobility of the register in a locked open position.

BURNER FLAME SIGHTGLASSES - The inspection or observation port sightglasses located at the burner front need to be cleaned, during an outage, to maintain their clarity for visual inspection on verifying and troubleshooting fuel oil and coal flames.

SPIN VANE GEAR ASSEMBLIES - Inspect and clean any fly ash accumulation between the gear teeth assemblies of the spin vane (inner air) registers. This accumulation prevents problems while the unit is on line. The fly ash accumulation can be scraped and wire brushed off.

BURNER THERMOCOUPLE UPGRADE - Complete external hookup of the temperature measurements for the burner fronts from the junction box on the windbox to the information computer FIO. Reformat existing Foxboro 1A screens to represent all (48) burners with outer register backplate and coal nozzle tip temperatures only. Note; this item will be covered by a Construction Modification Package (CMP).

This upgrade was necessary for monitoring cooling air flow requirements to out-of-service burners by providing more information on overheat conditions, plus for the detection of burner line coal fires on any of the burner lines.

Unit 2 needs the same thermocouple modification made to the burners. Currently, only every other burner has any temperature indication. See enclosed drawing markups for thermocouple locations.

BURNER FRONT TEMPERATURE ALARMS - Investigate lowering stainless steel burner front temperature alarm limits from 1350 degrees F to 1200 degrees F. In an attempt to keep the burners from overheating and burning up, increase minimum cooling air flow requirements to the out-of-service burners. As previously discussed, this will significantly reduce boiler efficiency.

By increasing burner cooling air flow requirements, the secondary air requirements increase which in turn increases the dry gas loss out the stack, increases the air leakage losses (since the additional air is not combustion air), plus also increases FD and ID fan horsepower requirements.

In addition, with the upper burner rows out-of-service, it is difficult to make main steam temperatures. The additional cooling (leakage) air enters and acts as blanketing air over the secondary superheat platens (although this is an excellent NO_x reduction technique). At lower loads, this problem compounds itself because with multiple pulverizers out-of-service, that much additional cooling air flow is required.

LIGHTER SHROUDS - Inspect lighter shrouds from the fireside of boiler off the boiler platform in future outage inspections to repair or replace any broken U-straps and attachment welds. This is to prevent shrouds from falling out into the fireside of the boiler.

Increasing cooling air requirements to out-of-service burners will also reduce overheating conditions on the shrouds, attachments and on the inner air sleeve.

LIGHTERS - Maintain original weekly Preventative Maintenance Program on the lighters and sparkers to ensure adequate lighter availability and reliability. Also, during each and every outage all lighters should be PM'd due to their heavy reliance and usage on start-up after an outage. The availability of lighters and sparkers are critical on maintaining unit start-up schedules.

Entire lighter assemblies should be pulled annually for checkout and cleaning. Cooling air flow holes should be checked and cleaned to ensure adequate cooling. Fuel oil valves should be repaired if any evidence of oil leakage is occurring on the lighter assemblies.

SCANNERS - Care must be taken when shooting off eyebrows and slag on furnace walls with a shotgun (on unit shutdowns prior to an outage) to prevent damage to scanners and lighters.

Scanners should be PM'd annually during available maintenance outages. Grounding problems with the scanners need to be resolved to eliminate scanner malfunctions (flame detection without burner group inserted). This item should be given top priority and handled as a safety issue.

INNER AIR SLEEVE ASH DEPOSITS - Investigate increasing windbox duct pressures on both in-service and out-of-service burner rows to increase velocities across the spin vanes to prevent ash deposits and fallout from occurring on the tip of the inner air sleeves.

WINDBOX FLY ASH ACCUMULATION - Vacuum fly ash accumulations in the bottom of the burner windboxes during maintenance outages. Typically, problems exist on the first and third burner levels (Pulverizers 1B, 1G, 1A and 1H) between the second and fourth burners. Also, investigate the cause and resolve the problem.

COAL DUST ON BURNERS - Coal dust, exterior to the windbox on the burner fronts that settles out on the coal nozzles, elbows, lighters, sparkers, scanners, burner lines, etc., poses an extreme fire hazard and should be cleaned up thoroughly during each available outage. Locate and repair all sources of coal leaks during these outages. Most coal leaks are at coupling locations along the coal burner lines.

INNER AND OUTER REGISTERS - Verify during major outages that all outer and inner (spin vane) air registers are moveable and in proper working condition. Inspect all linkages and gear assemblies and stroke to verify movement. Also, clean any ash or slag deposits accumulated around the spin vanes located in the inner air sleeve which may disrupt air flow and impair flame stability.

BURNER AIR REGISTER SETTINGS - Immediately following outage shutdowns, when the windboxes are accessible for inspections (prior to any burner work activities), document the inner (spin vane), outer and backplate air register positions. This information will be used to determine if any changes have been made while the unit was on-line and if potential problems have developed because of these outage.

Investigate elevating windbox pressures to two to three inches water column (positive) by pinching down the inner, outer and backplate registers. This should increase velocities through the registers and help prevent ash and slag accumulations on the inner air sleeve. Hopefully, this will also improve the overall combustion and oxygen profiles and balancing.

After all outage work activities on the burners are complete, reset and verify final register position settings. Document these final settings and mark with ink pen the outer register handle positions if different from previous settings.

BURNER PERFORMANCE AND COMBUSTION TESTING - Conduct burner/pulverizer turndown testing immediately following outages to verify flame stability and balancing through each feeders load range. Also check out scanner setup and alignments and resolve any instability or sighting problems. Oxygen profiles should also be conducted shortly thereafter to ensure all combustion and burner performance requirements have been met.

SECONDARY AIR FOIL CHECKS - The I&C Department, on an annual basis, should conduct an air leak test on the secondary air foils to verify there is not a leakage problem in the instrumentation lines that could effect combustion air flow measurement and control.

WINDBOX DAMPER CHECKOUT - I&C should also stroke all secondary air windbox dampers annually to confirm proper linkage alignment, damper position indication (checked with angle finder), cold clearance settings and full range of motion.

PRIMARY AIR FLOW CALIBRATION AND CHECKOUT - Annual checks should also be made during outages on the primary air flow averaging probes and instrumentation lines. Air pressure checks from the probes to the instrumentation cabinets would verify that no leakage points exist.

Calibrations should also be made (annually) on the primary air flow transmitters to verify proper air flow velocities through the pulverizer and coal burner lines. The calibration checks, utilizing a fechheimer probe and VPAS (velocity/pressure averaging analyzer), should be done with the unit on line. Engineering Services has the necessary equipment to conduct the calibrations.

COMPARTMENTALIZED AIR FLOW MEASUREMENT - Compartmentalized windbox secondary air flow measurement should still be investigated as having merit in monitoring, controlling and balancing combustion and cooling air requirements to the burners.

An industrial grade hot wire anemometer such as the Kurtz EVA system could have application for this situation. We would like to recommend a system set up on a trial basis on a top row rear burner level on Unit 1 (where the HD outer air registers are installed) to determine the effectiveness of such a system.

BURNER PRINTS UPDATED - B&W needs to supply updated prints on the final burner assemblies showing all modifications. These items include in part; burner nozzle tip modifications, lighter shroud assembly modifications, thermocouple placement, HD outer register upgrade, register drive handle slip joints, outer register linkage stops, inner and outer register handle paddle lock attachment, thermal expansion modification for outer air sleeve assembly, recommended final register position set up, etc.

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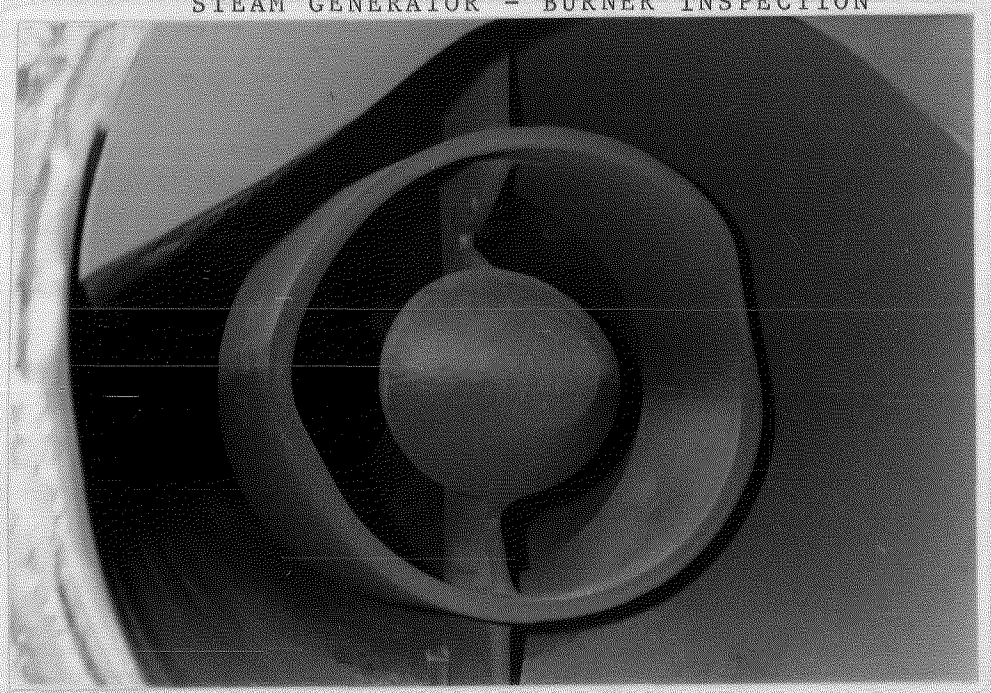

Photo 1 - Coal Burner 1A04's conical coal diffuser showing extreme wear on upper vertical strut above the cone. Diffuser was replaced.

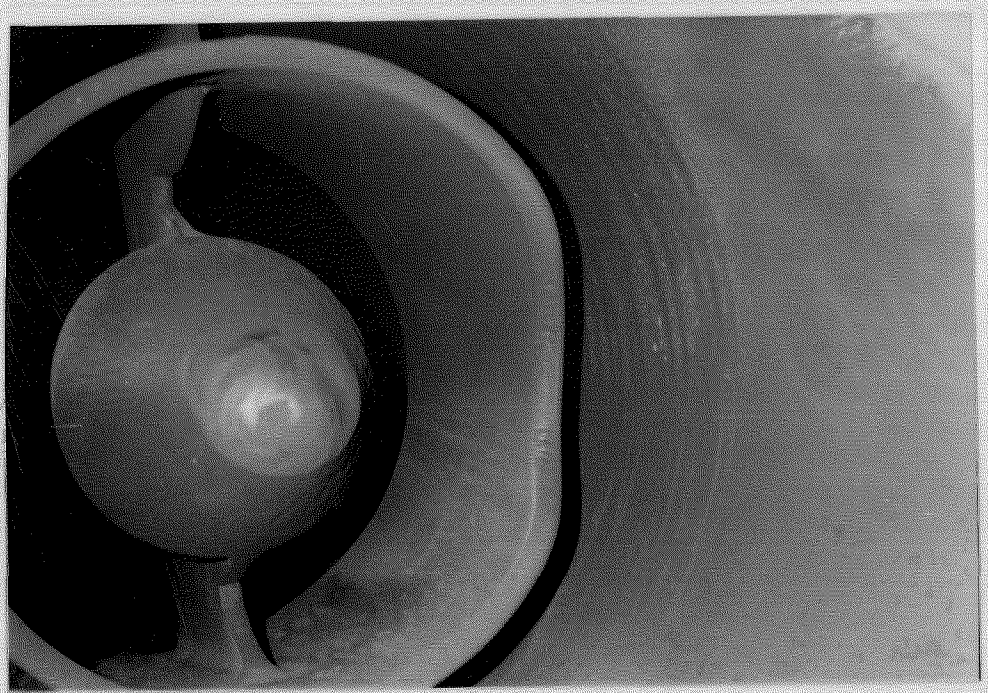

Photo 2 - Conical diffuser for Burner 1A06 showing excessive wear on the upper vertical strut. This diffuser was also replaced.

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Photo 3 - Backside view of the conical diffuser for Burner 1A06 showing vertical bracket wear. Picture was taken during furnace side inspection from the boiler platform.

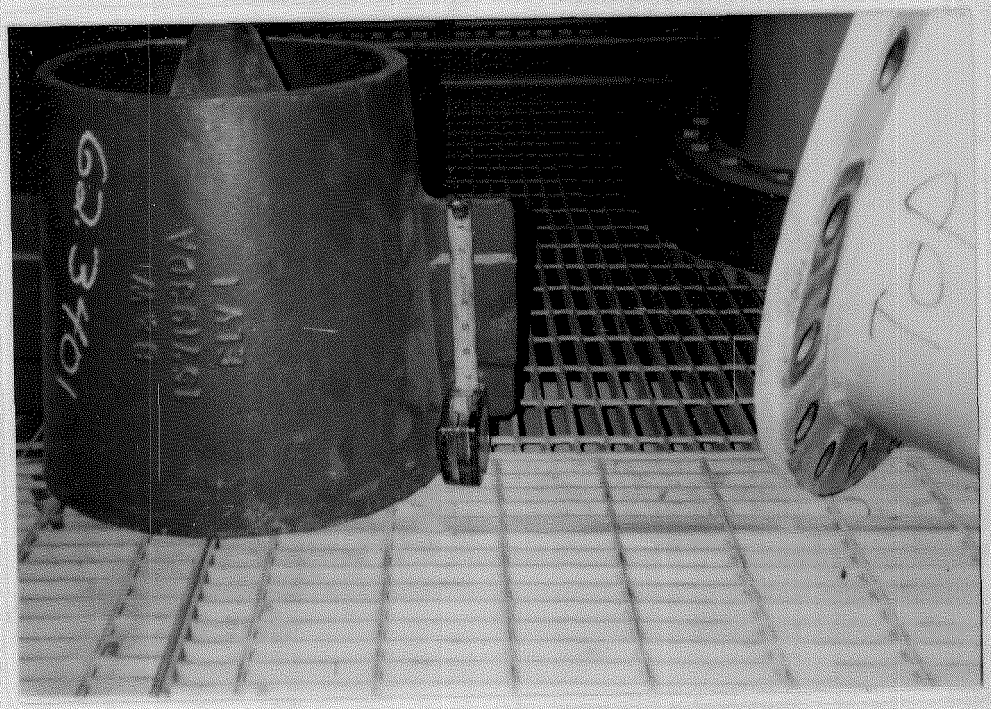

Photo 4 - New conical diffuser prior to installation during

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Photo 5 - Plasma torch ceramic lined sleeve installation on lower row burners with end pluggage (typical), as viewed from furnace.

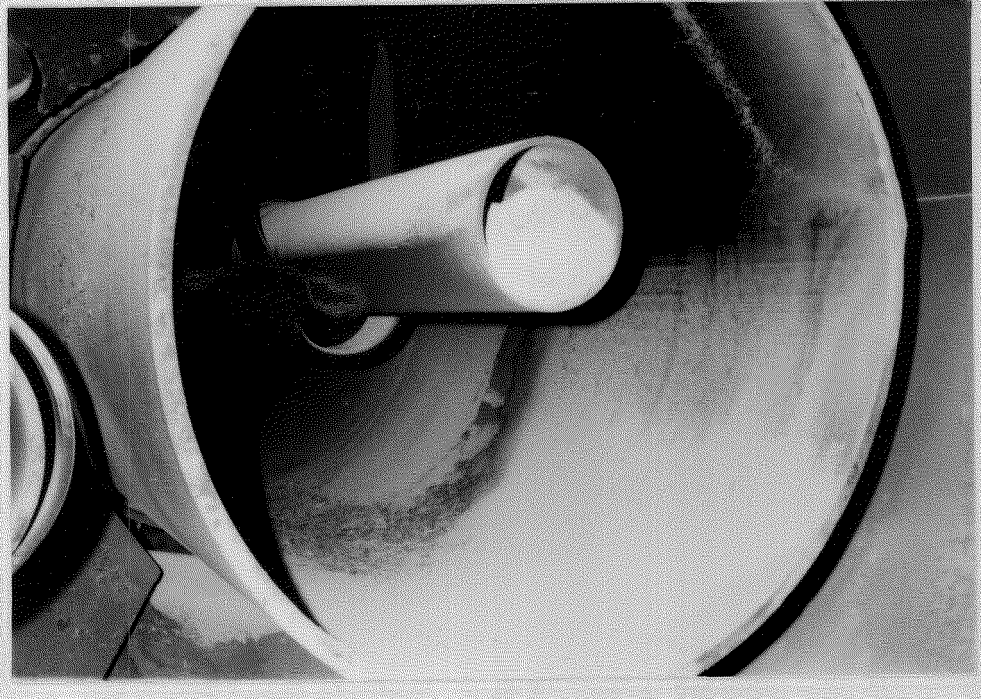

Photo 6 - Misaligned plasma torch sleeve not resting on U-bracket support at burner nozzle tip.

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Photo 7 - Plasma torch sleeve U-bracket support showing concentrated erosion against outer wall of burner nozzle (typical).

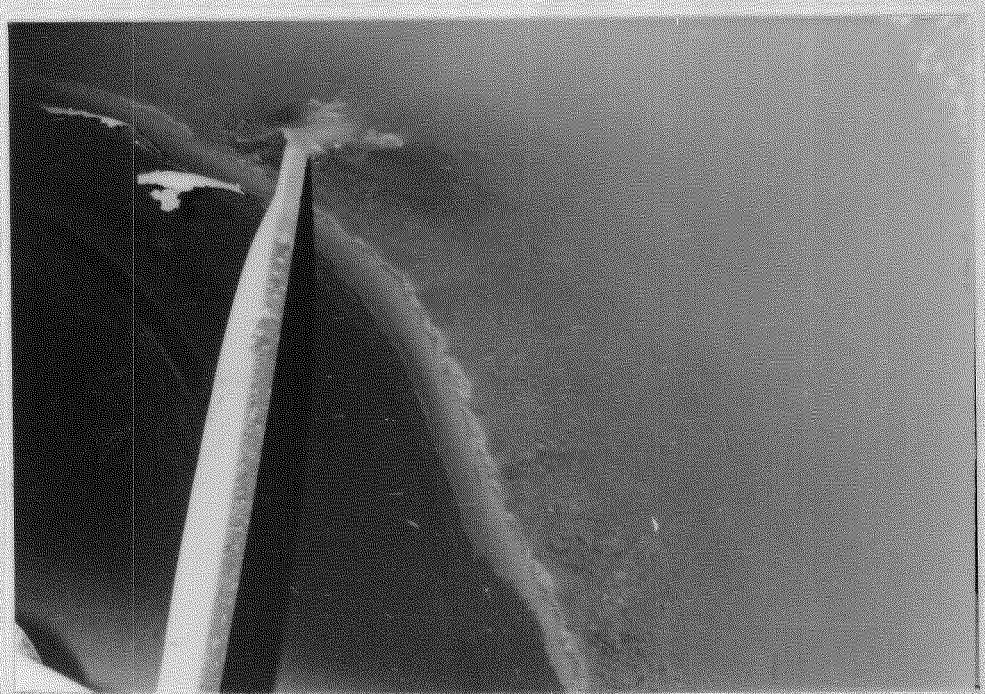

Photo 8 - Extreme wear on the U-bracket support as shown on Burner 1B04. All U-brackets were replaced and repaired.

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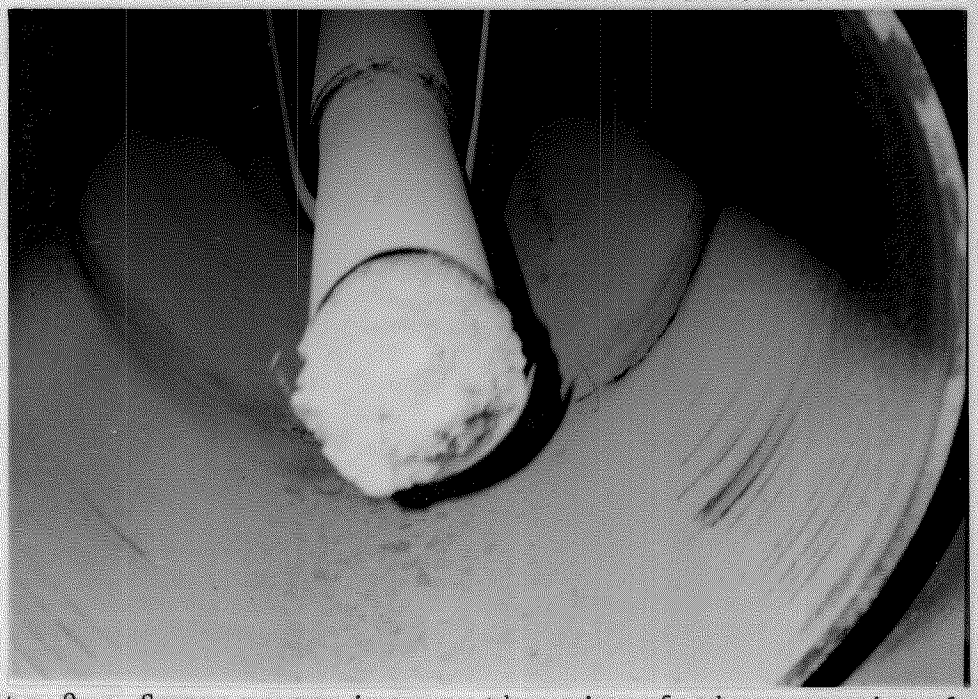

Photo 9 - Severe erosion on the tip of the ceramic plasma torch sleeve on Burner 1B04.

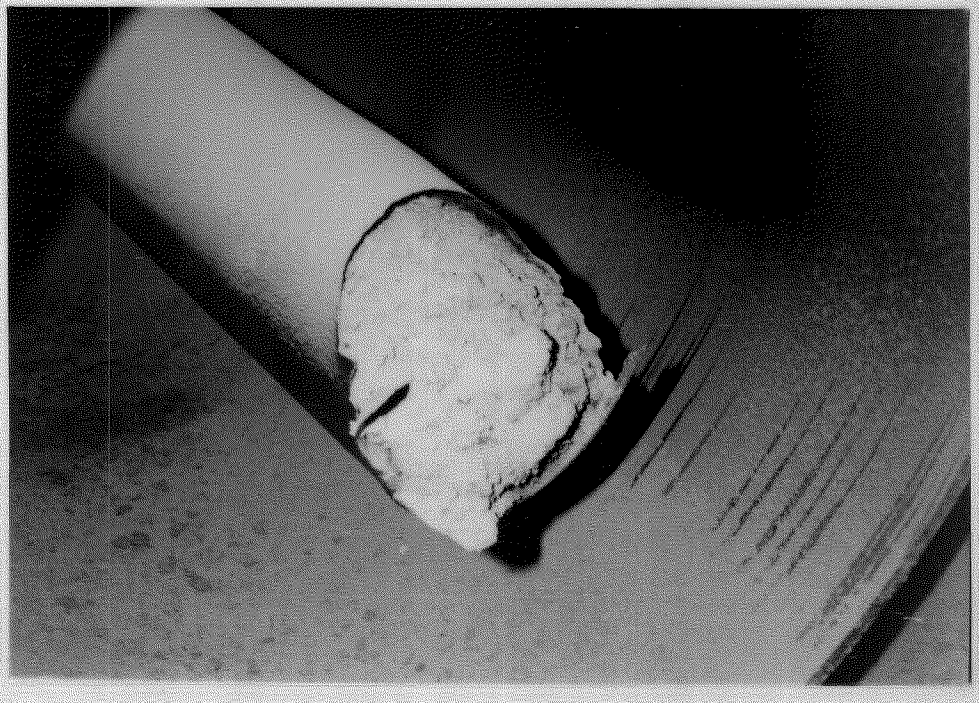

Photo 10 - Another view of Burner 1B04 end tip erosion.

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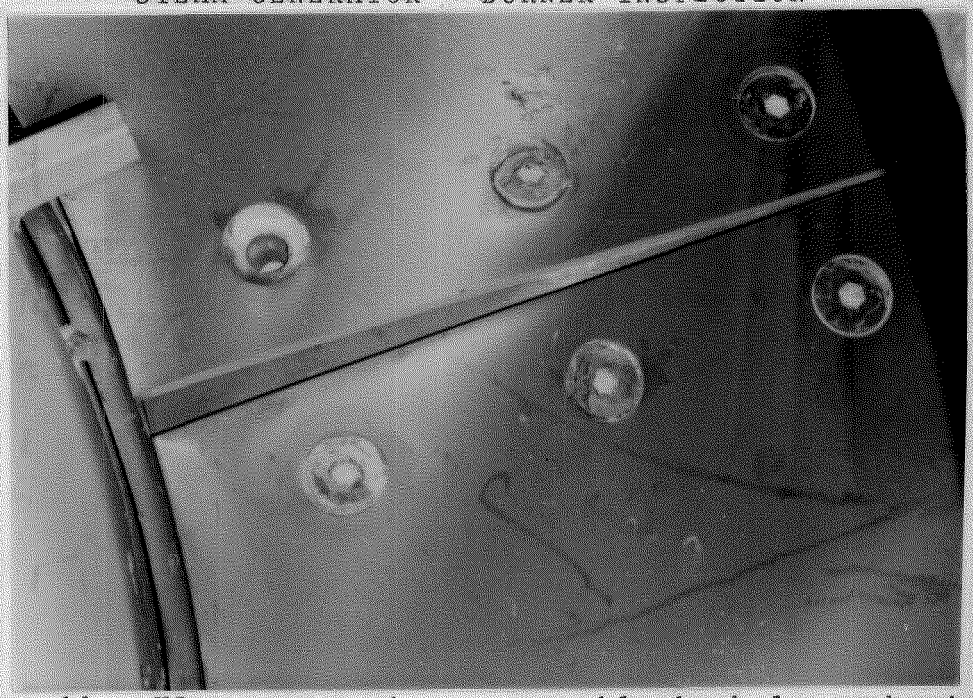


Photo 11 - HD outer register assembly backplate showing overheat and thermal expansion at bolted joints. Typical of top row burners where HD's are installed.

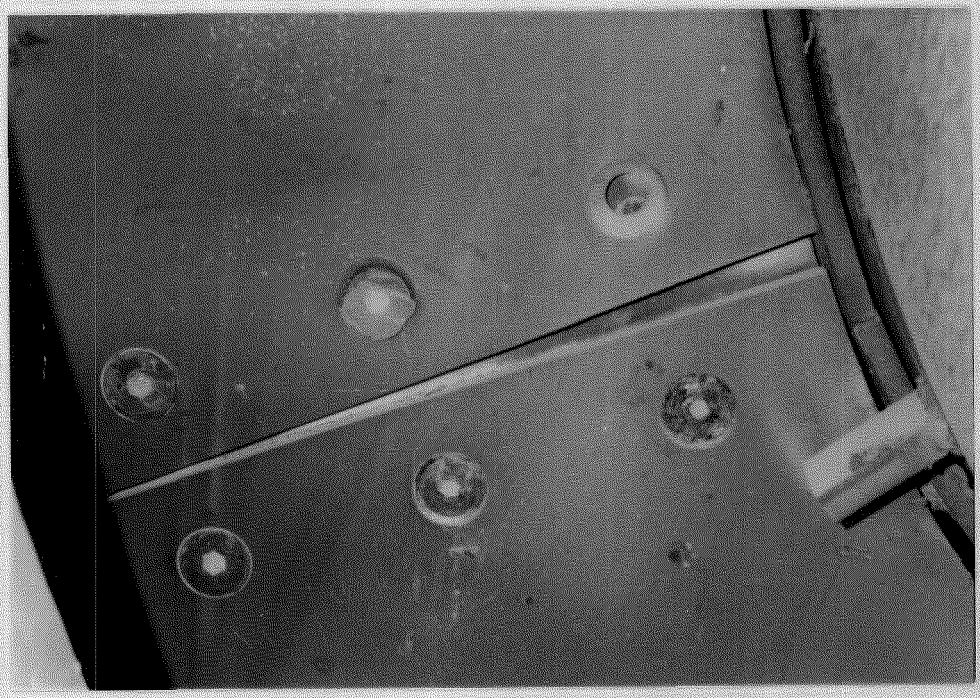


Photo 12 - Overheat and thermal expansion damage to HD outer air register assemblies.

STEAM GENERATOR - BURNER INSPECTION

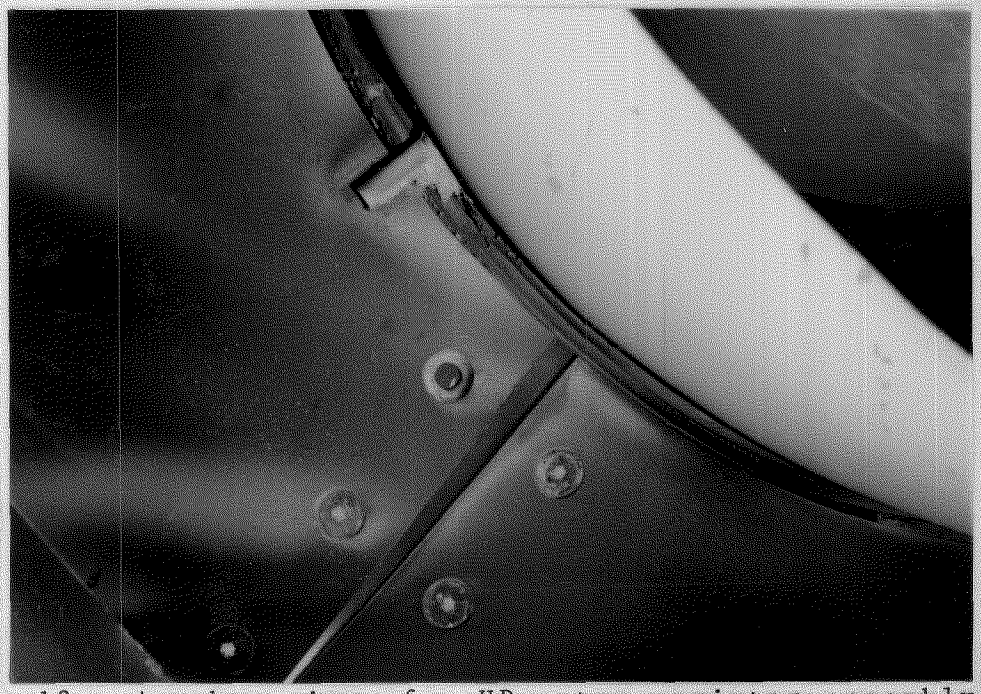


Photo 13 - Another view of a HD outer register assembly with an overheat condition causing permanent expansion damage.

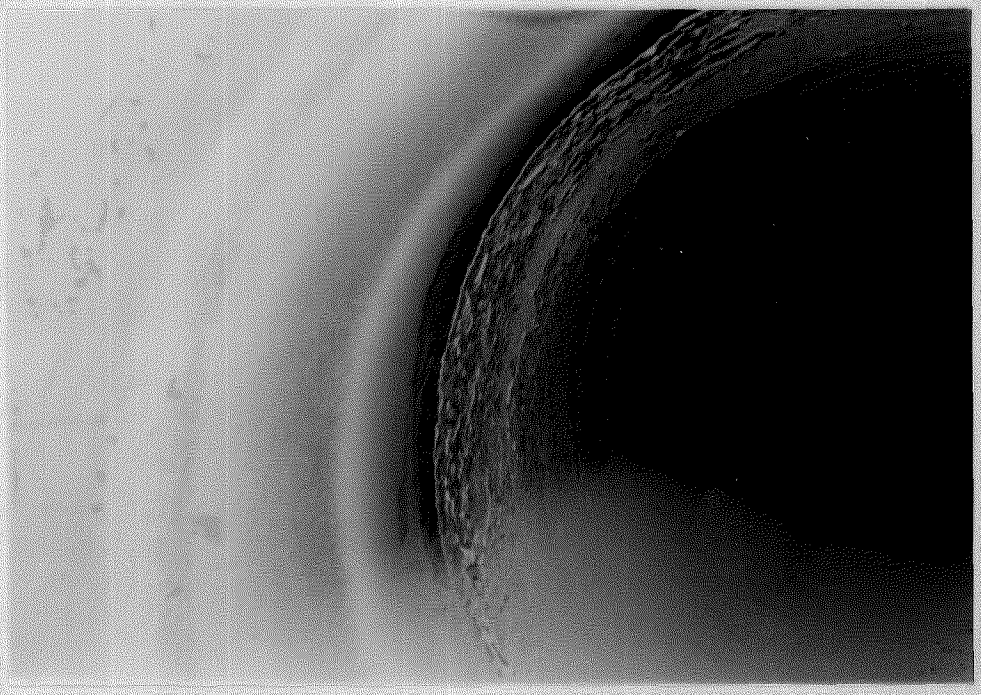


Photo 14 - Interior of coal nozzle tip (from furnace side) showing carbon steel portion flaking and the stainless steel tip belling-out or barreling from thermal expansion.

STEAM GENERATOR - BURNER INSPECTION

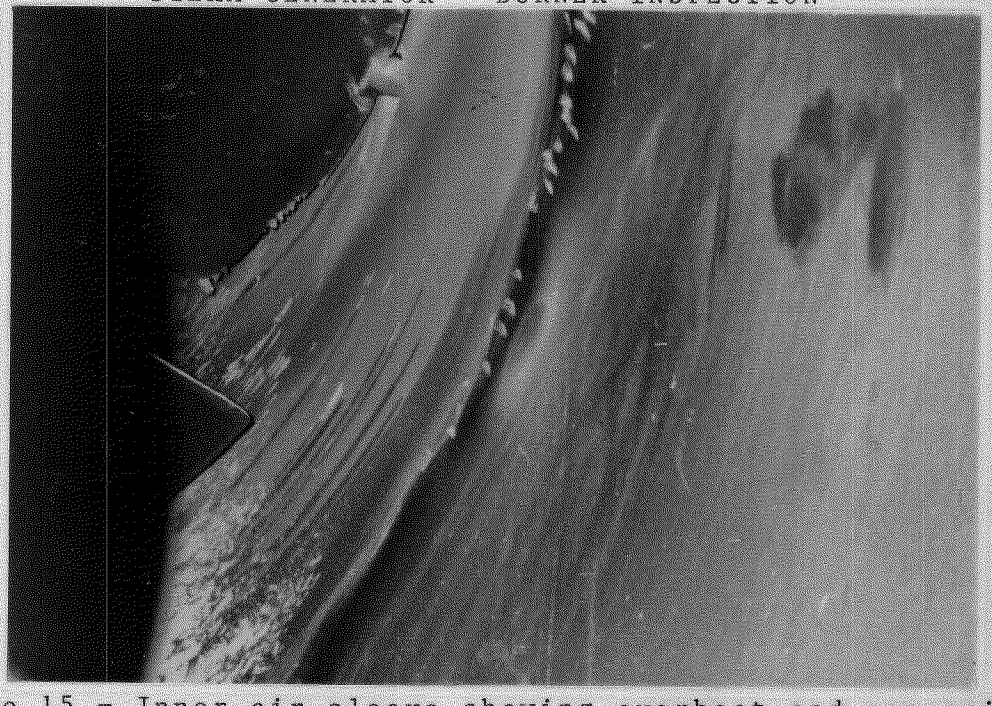
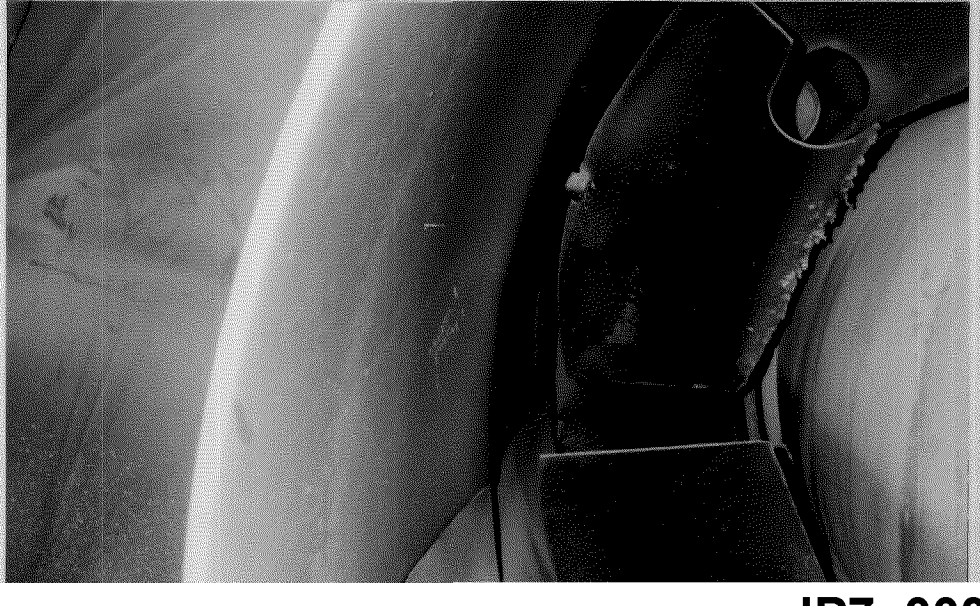


Photo 15 - Inner air sleeve showing overheat and expansion with rippling along seam weld (Burner 1E05).



STEAM GENERATOR - BURNER INSPECTION

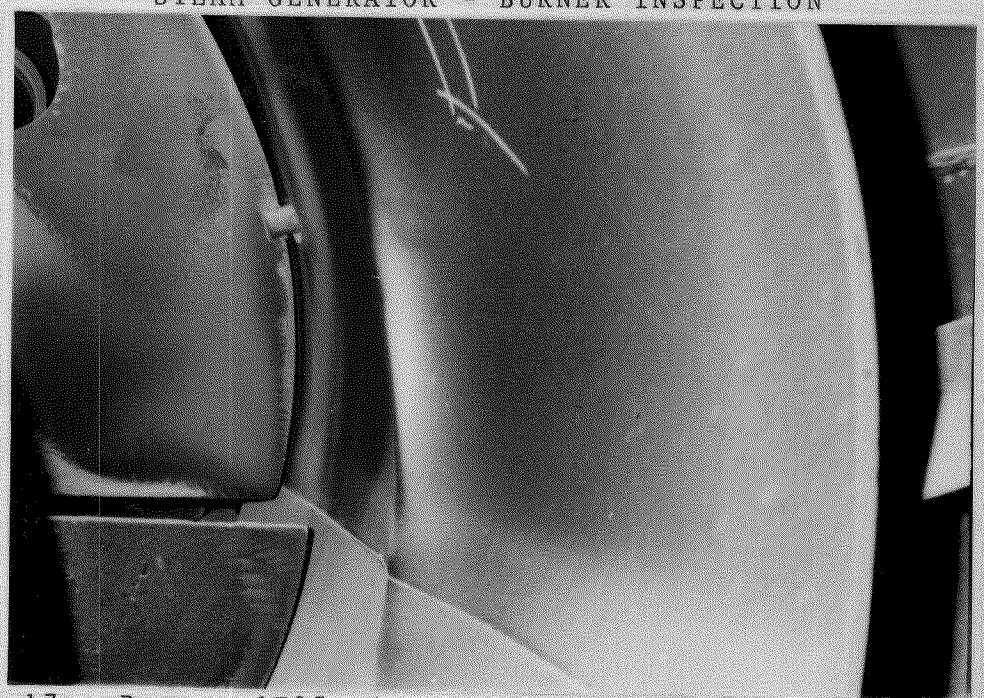


Photo 17 - Burner 1F05 also showing warping on outer portion of inner air sleeve as seen from furnace.

Photo 18 - Warping or rippling of throat sleeve casing ring.

STEAM GENERATOR - BURNER INSPECTION

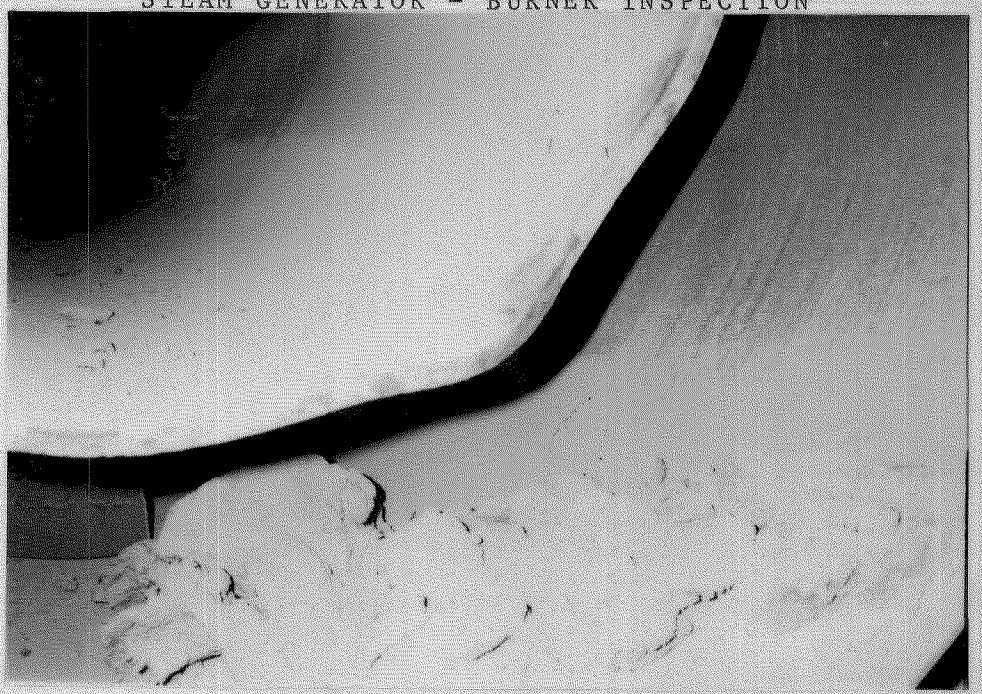
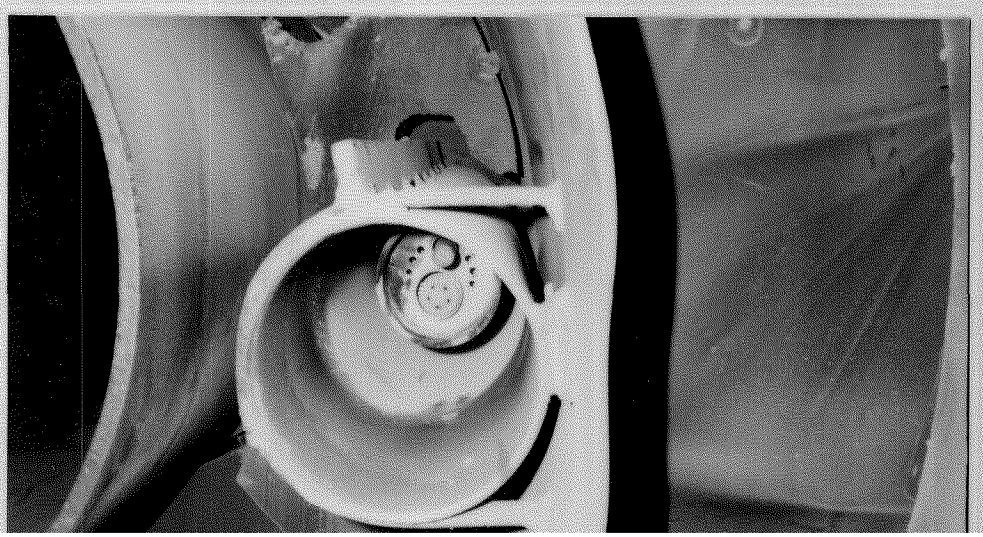


Photo 19 - Warping of a coal nozzle tip due to overheat conditions.



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STEAM GENERATOR - BURNER INSPECTION

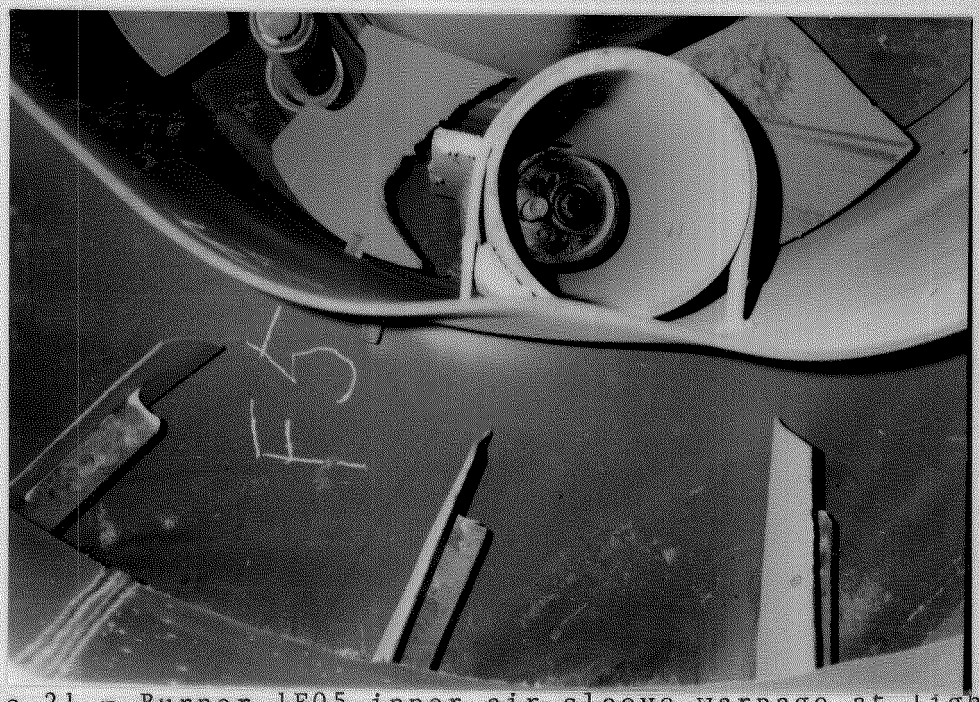

Photo 21 - Burner 1F05 inner air sleeve warpage at lighter shroud attachment due to overheating.

Photo 22 - Outer air register back (rear) plate with evidence of overheating shown by thermal expansion and discoloration.

STEAM GENERATOR - BURNER INSPECTION

Photo 23 - Outer register front plate (from windbox) showing discoloration.

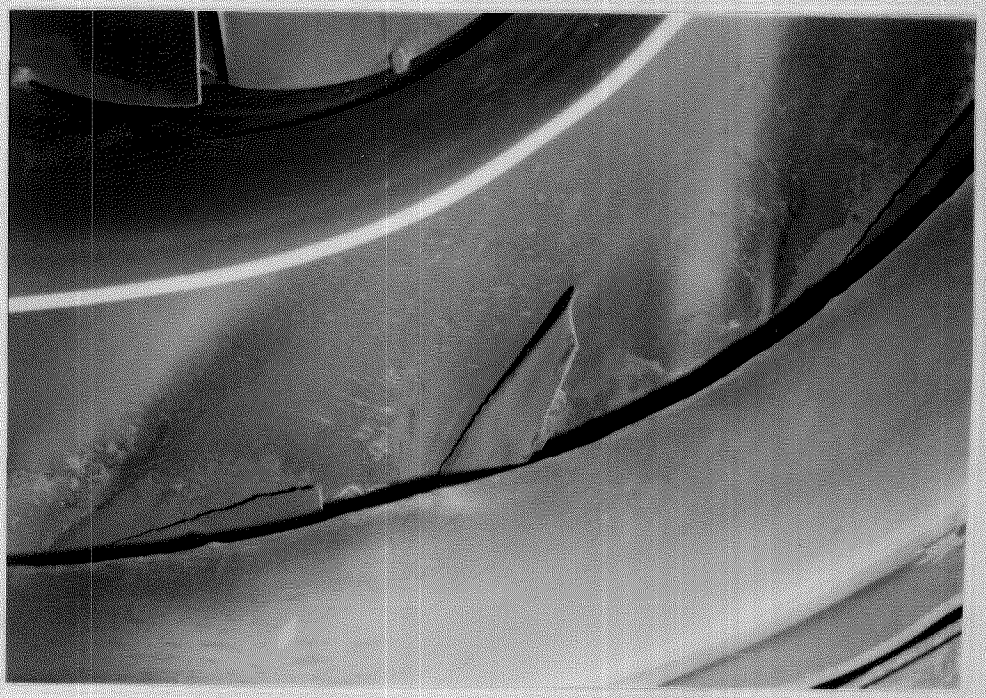

Photo 24 - Outer air register front plate showing metal discoloration and warping of throat sleeve casing ring.

STEAM GENERATOR - BURNER INSPECTION

Photo 25 - Inner air sleeve barreling or bell-outing just beyond the outer air sleeve backplate.

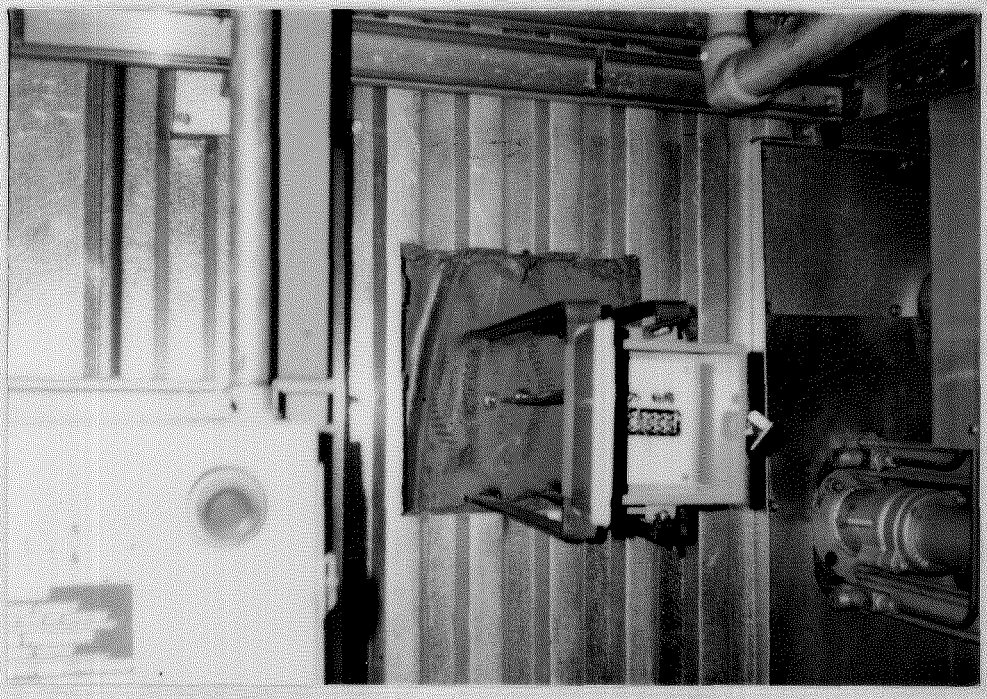

Photo 26 - Burner front thermocouples and junction box

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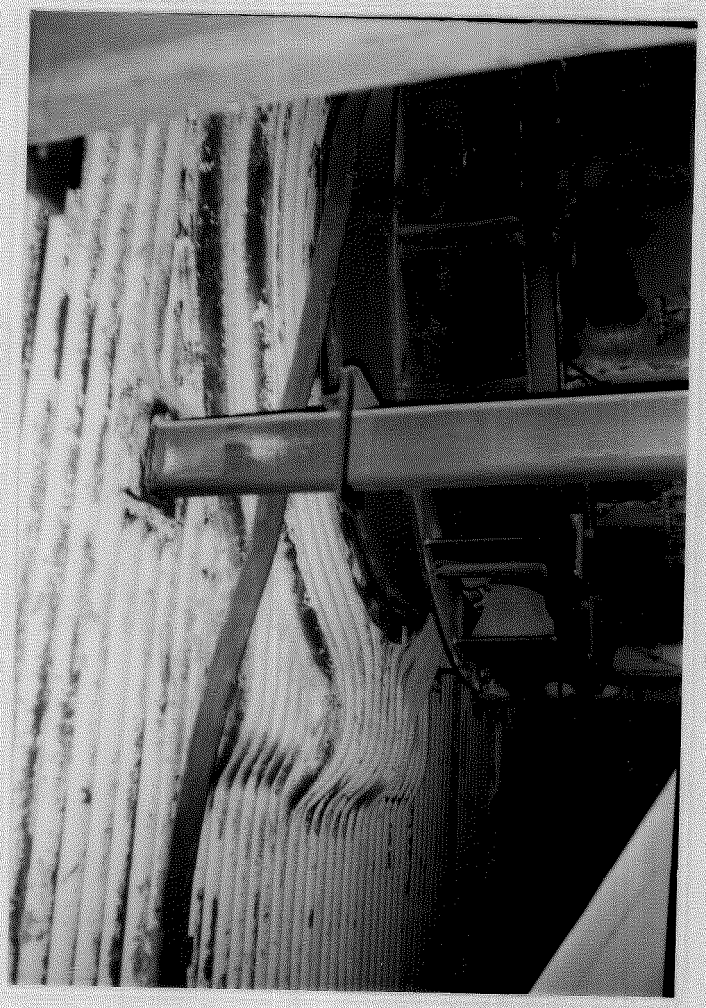

Photo 27 - Throat sleeve casing ring failure on Burner 1C04 due to broken welds and detachment.

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Photo 28 - Close-up of Burner 1C04 casing ring. Note one inch opening directly to furnace which allows air bypassing combustion zone.

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Photo 29 - Failed casing ring on Burner 1C04 showing open gap to furnace for combustion air leakage.

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Photo 30 - Burner 1C04 after casing ring repaired by Maintenance.

STEAM GENERATOR - BURNER INSPECTION

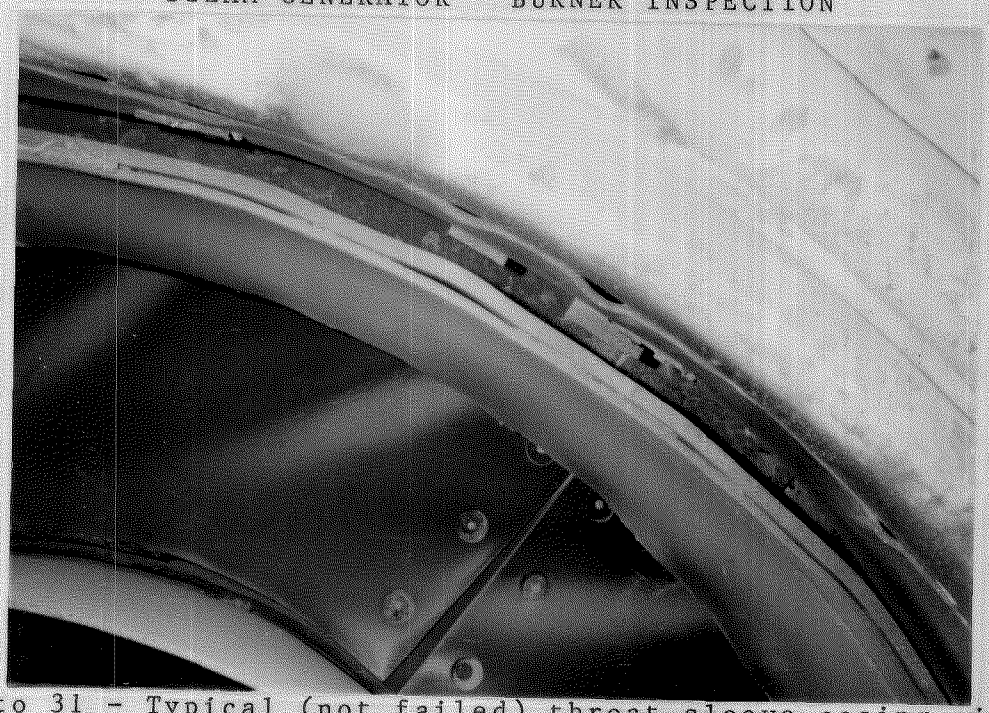

Photo 31 - Typical (not failed) throat sleeve casing ring, as shown from furnace side, showing deteriorated condition and gaps in the air tight seal.

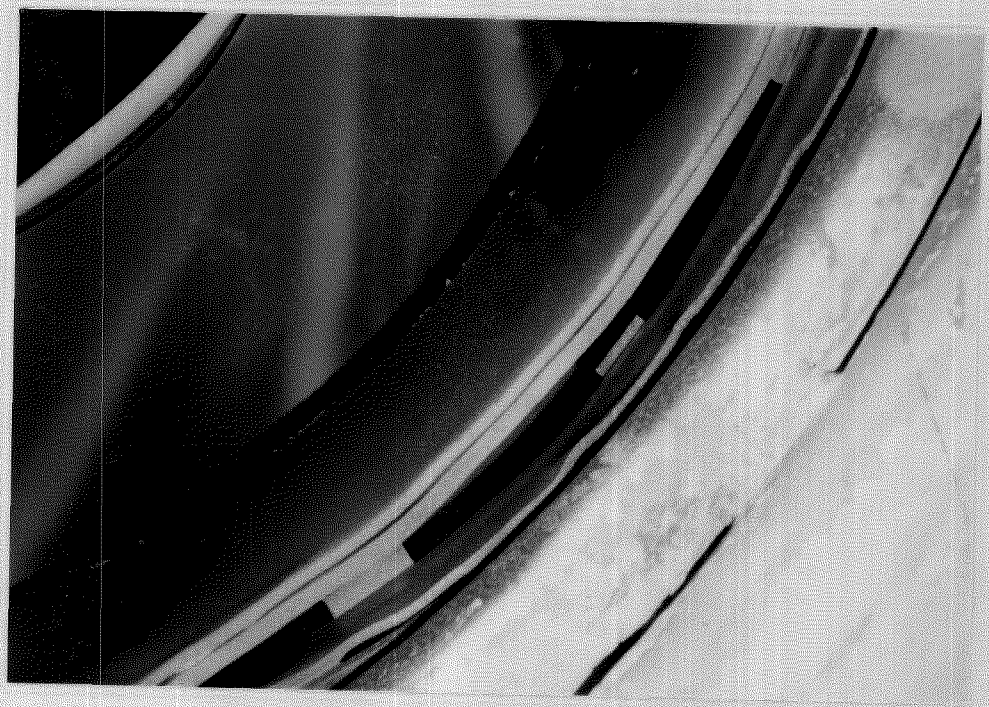

Photo 32 - Throat sleeve casing ring and seal showing signs of overheat and thermal expansion.

STEAM GENERATOR - BURNER INSPECTION

Photo 33 - Relative gap measurements on throat sleeve casing ring to waterwall showing the clearances which provide a major source for combustion air leakage.

Photo 34 - Relative gap measurements on throat sleeve casing ring to waterwall showing the clearances which provide a major source of combustion air leakage.

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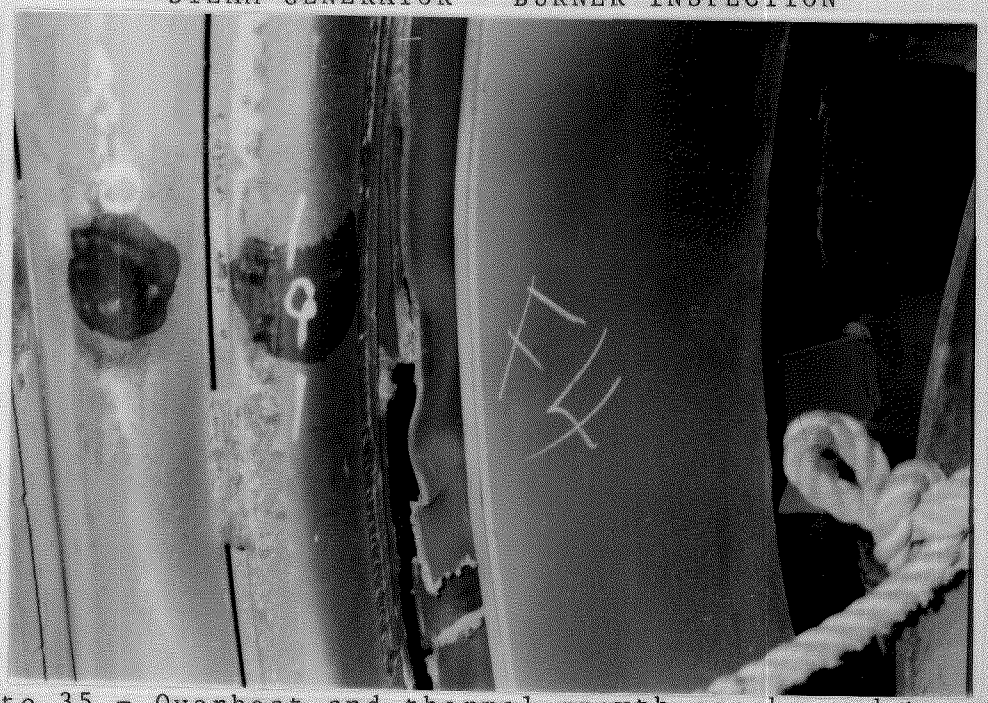

Photo 35 - Overheat and thermal growth cracks and tears on throat sleeve casing to waterwall front seal.

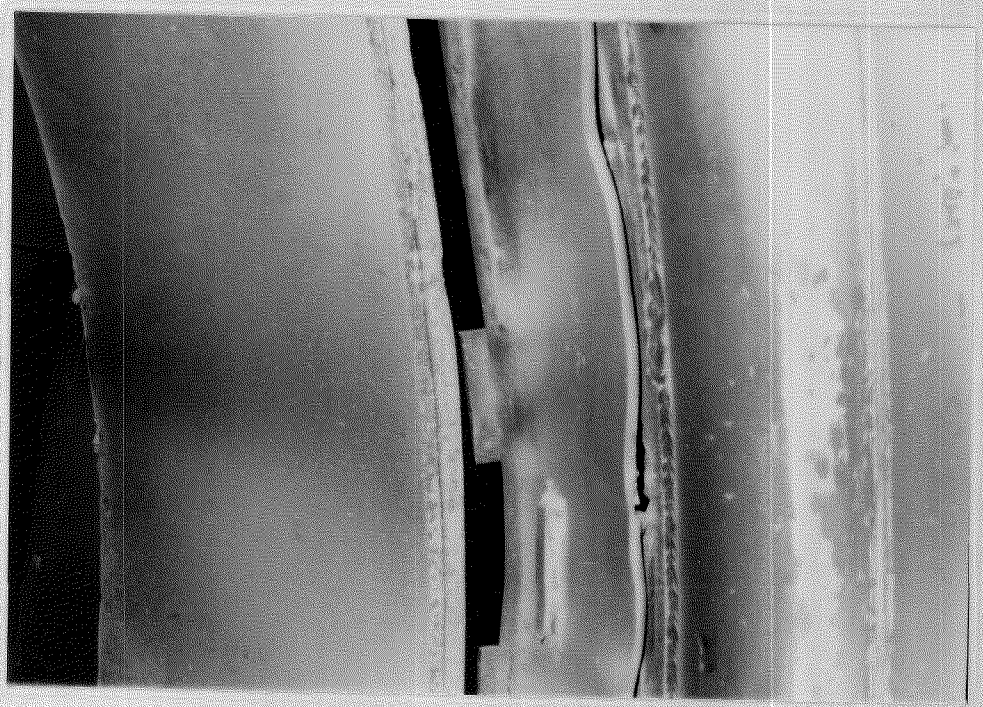

Photo 36 - Another view on a different burner of Photo 35.

STEAM GENERATOR - BURNER INSPECTION

Photo 37 - Additional photo of the burner front showing deteriorated condition of waterwall to throat casing ring seal.

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Photo 38 - Additional photo of the burner front showing deteriorated condition of waterwall to throat casing ring seal.

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STEAM GENERATOR - BURNER INSPECTION

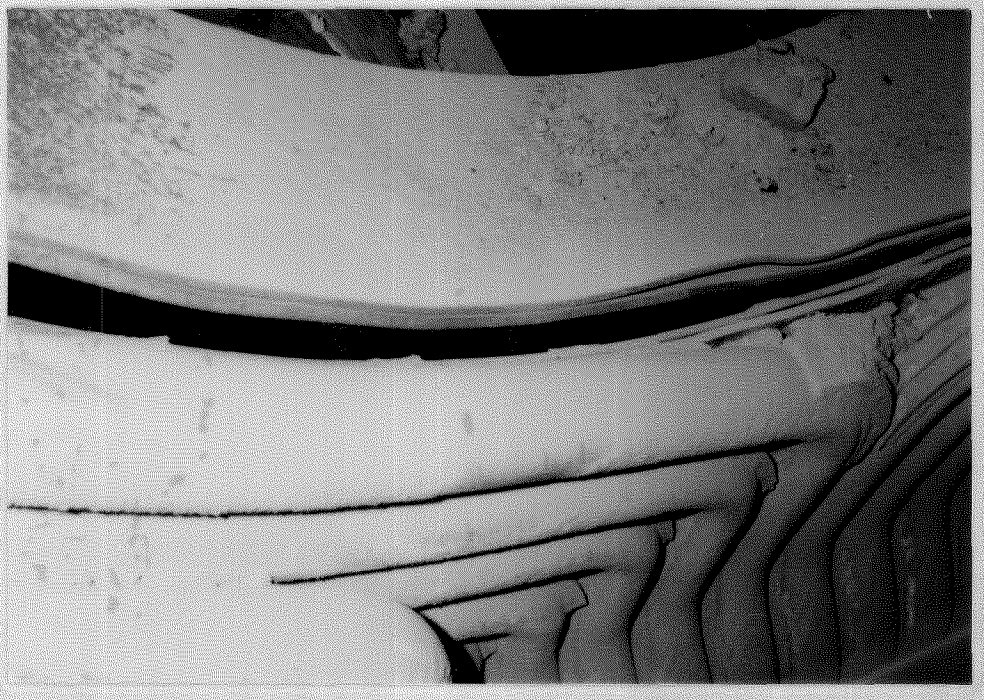

Photo 39 - Additional photo of the burner fronts showing excessive clearances around the outside of the burner assemblies.

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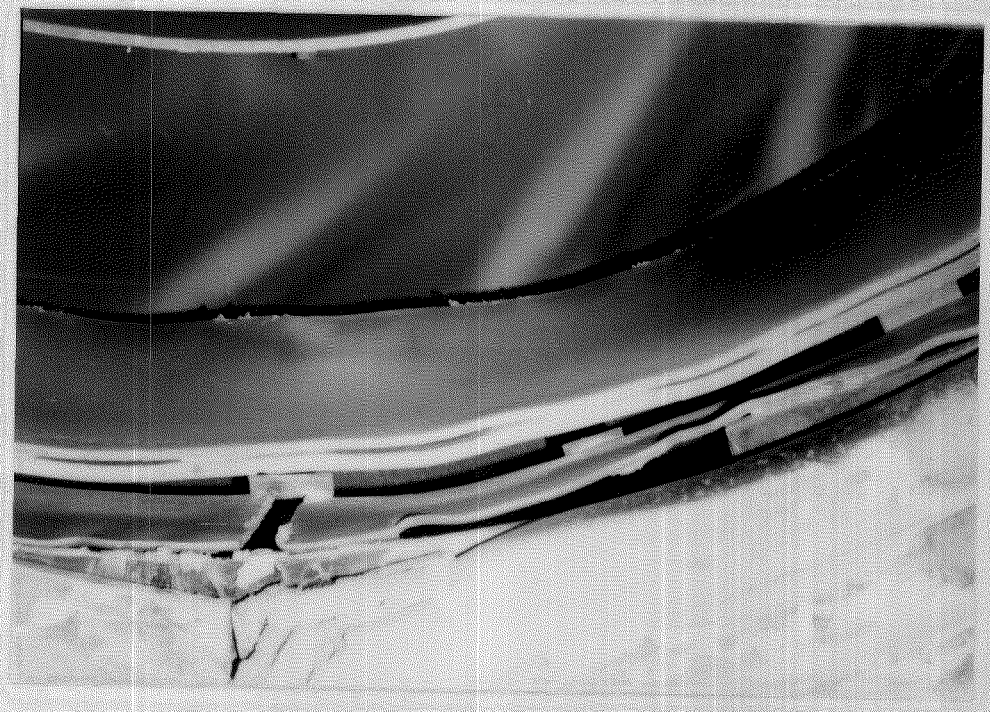

Photo 40 - Additional photo of the burner fronts showing excessive clearances around the outside of the burner assemblies.

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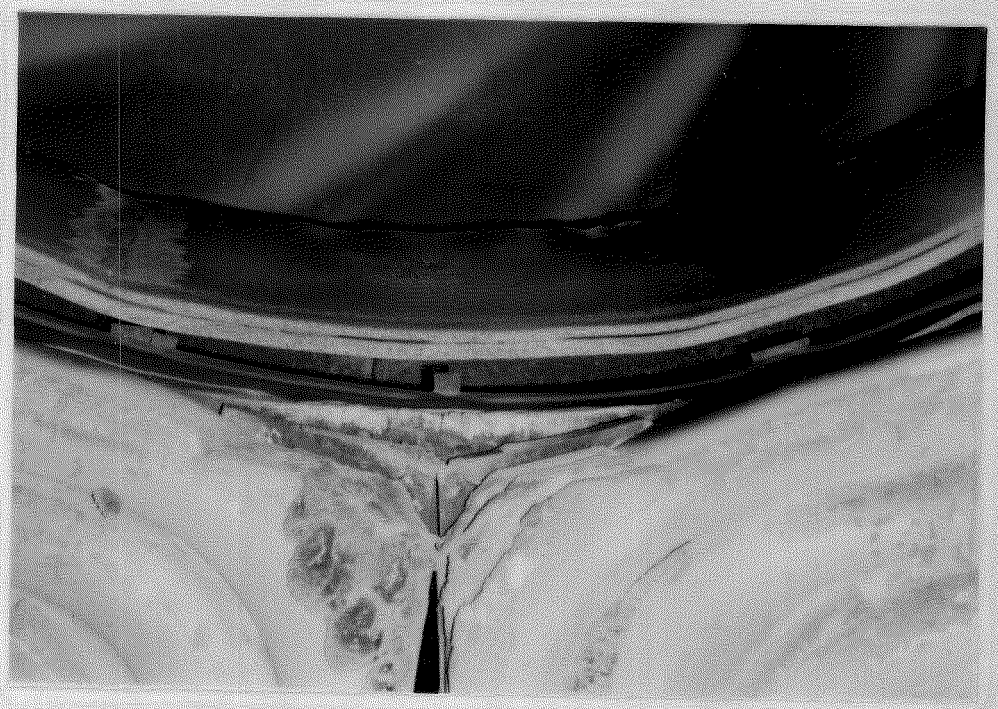

Photo 41 - Another photo, again showing the excessive gaps out around the burner front which allows maldistribution of combustion air.

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STEAM GENERATOR - BURNER INSPECTION

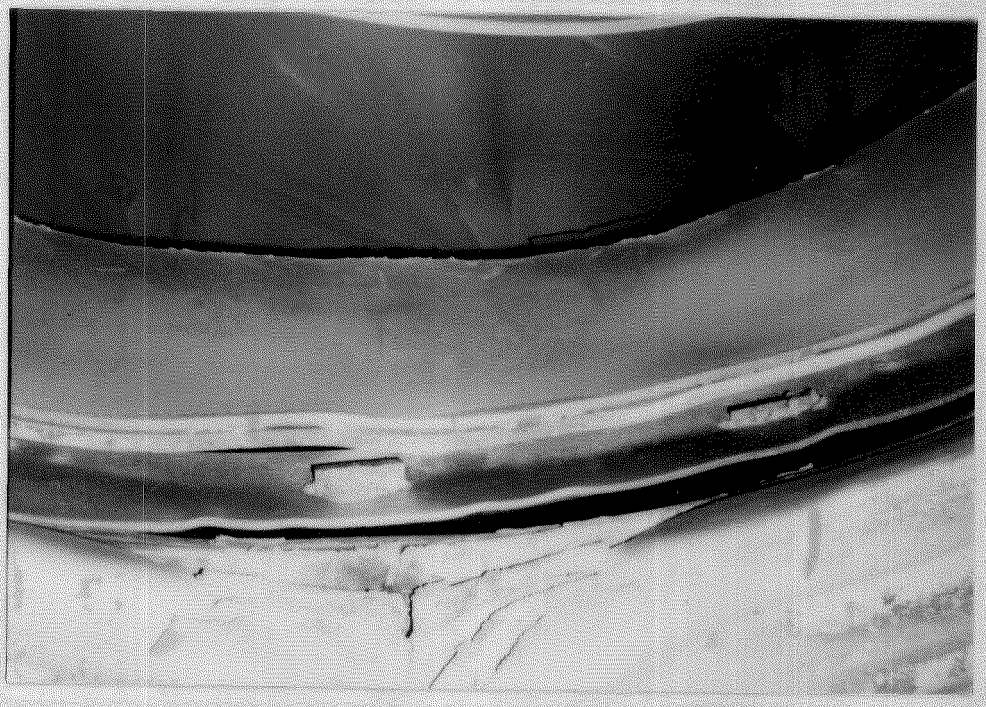


Photo 42 - Another photo, again showing the excessive gaps out around the burner front which allows maldistribution of combustion air.

STEAM GENERATOR - BURNER INSPECTION

Photo 43 - Deteriorated condition of the throat sleeve casing ring on Burner 1A04.

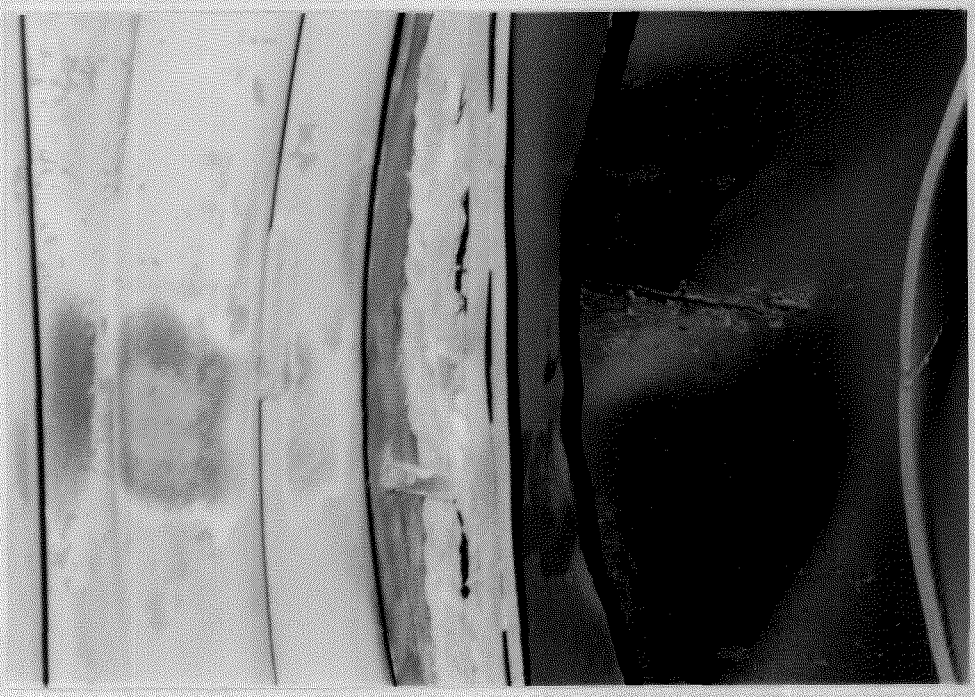


Photo 44 - One of the few burners which still has remnants of the rope packing seal originally designed to provide an air tight burner to waterwall seal.

STEAM GENERATOR - BURNER INSPECTION

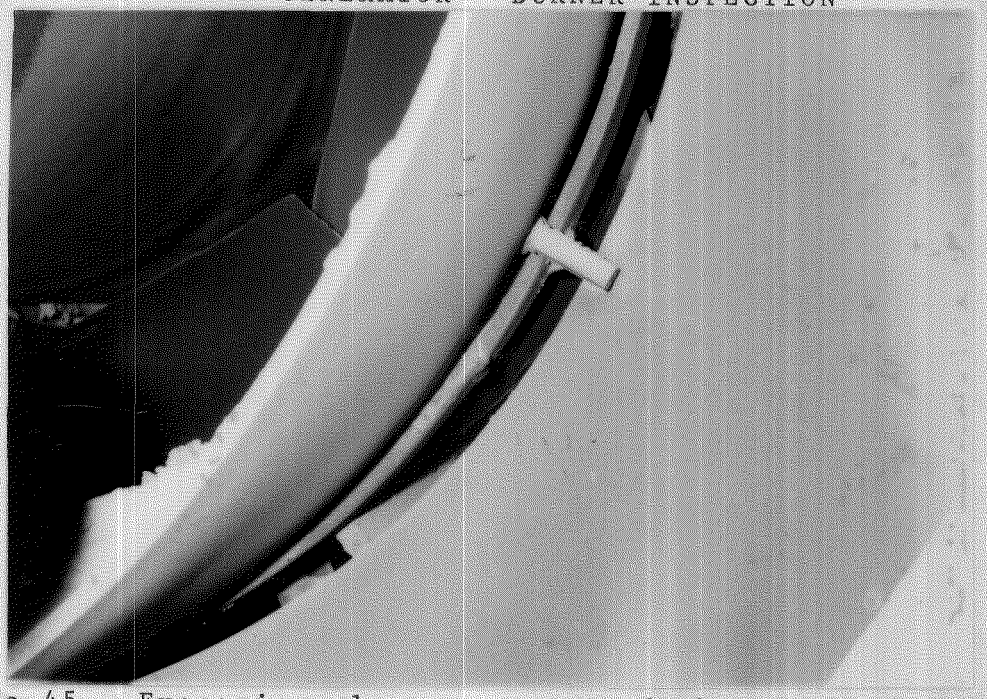
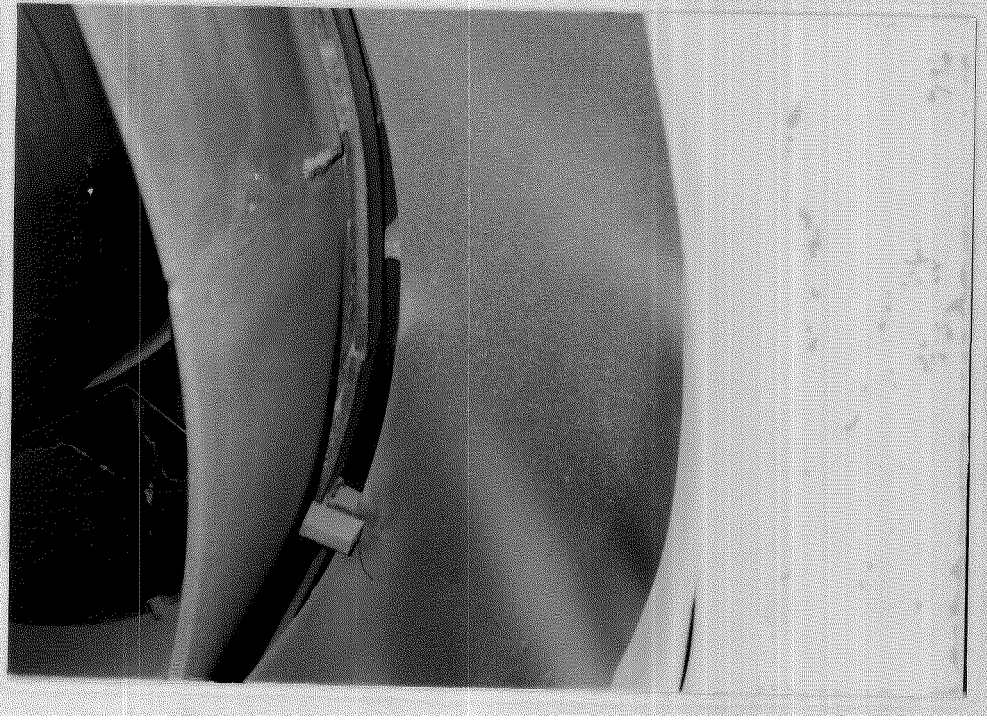


Photo 45 - Excessive clearances around the inner air sleeve where the outer air register assembly has been cut free to allow thermal expansion.



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STEAM GENERATOR - BURNER INSPECTION

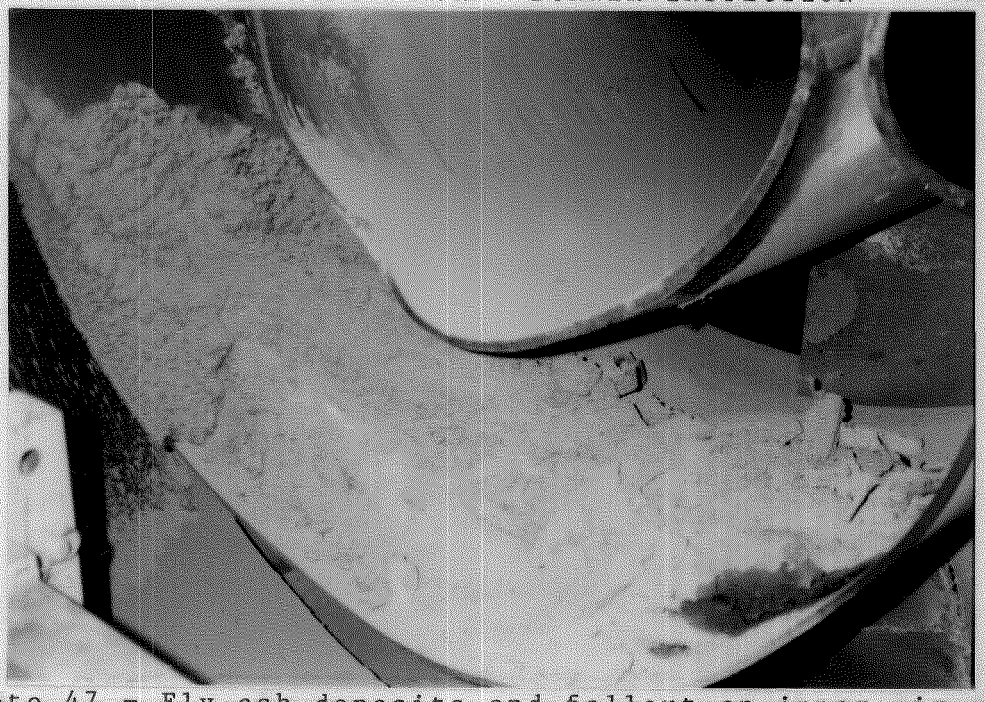

Photo 47 - Fly ash deposits and fallout on inner air sleeve of the burner as shown from fireside of the furnace.

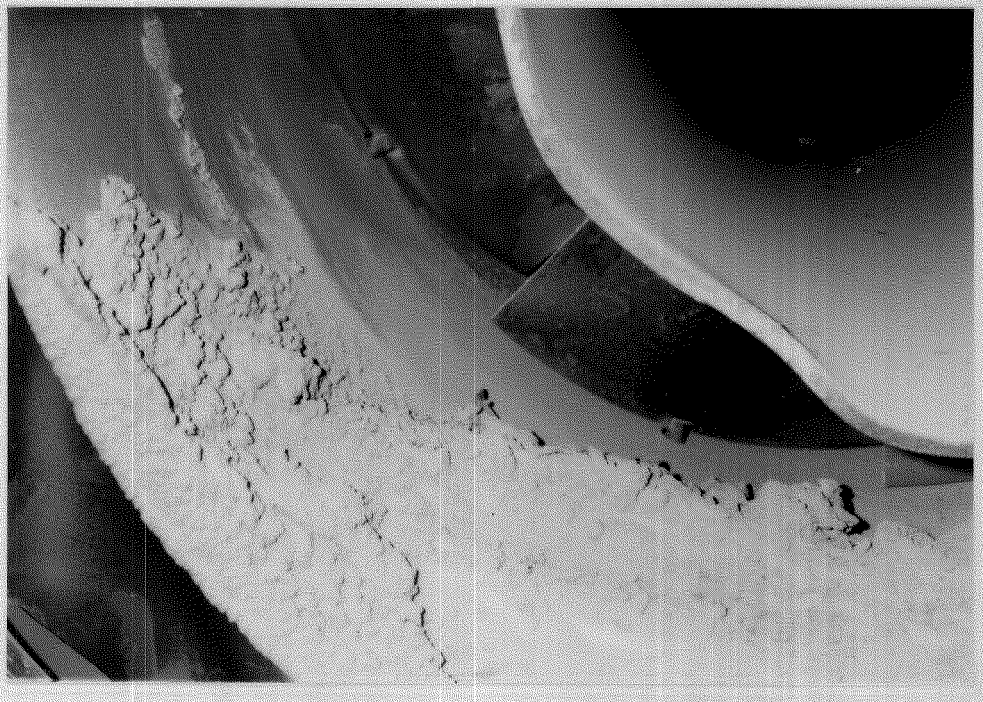

Photo 48 - Inner air sleeve with ash deposits settling on the bottom outer tip.

STEAM GENERATOR - BURNER INSPECTION

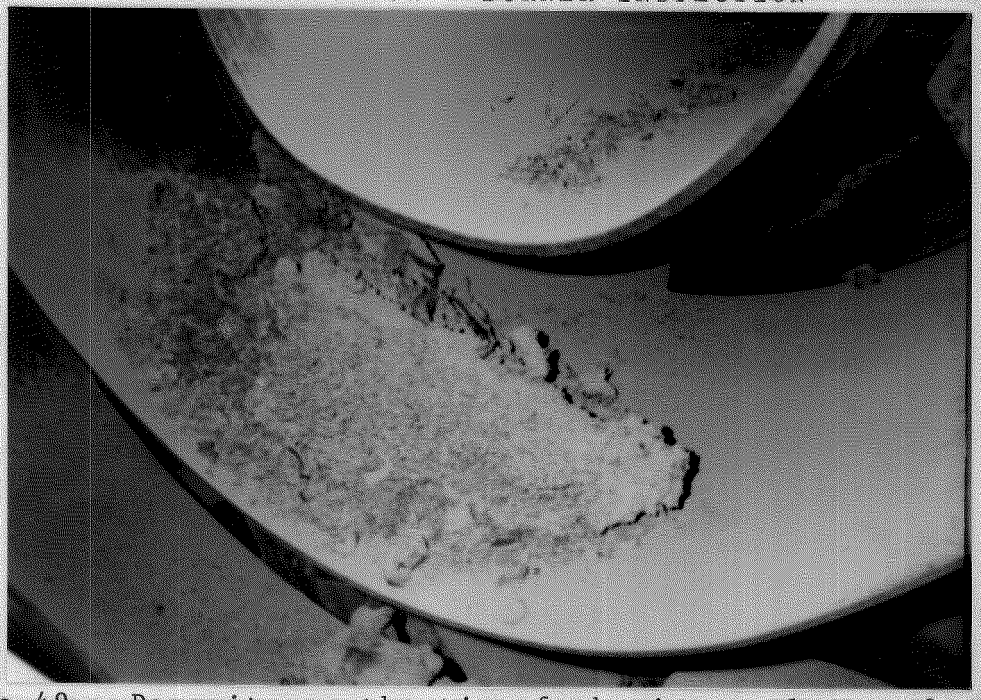

Photo 49 - Deposits on the tip of the inner sleeve of the burner. Note consistency of this ash as opposed to the deposits in Photos 47 through 51.

Photo 50 - Deposits on the inner air sleeve of the burner. Note comparison of the deposit which looks like solidified molten coal.

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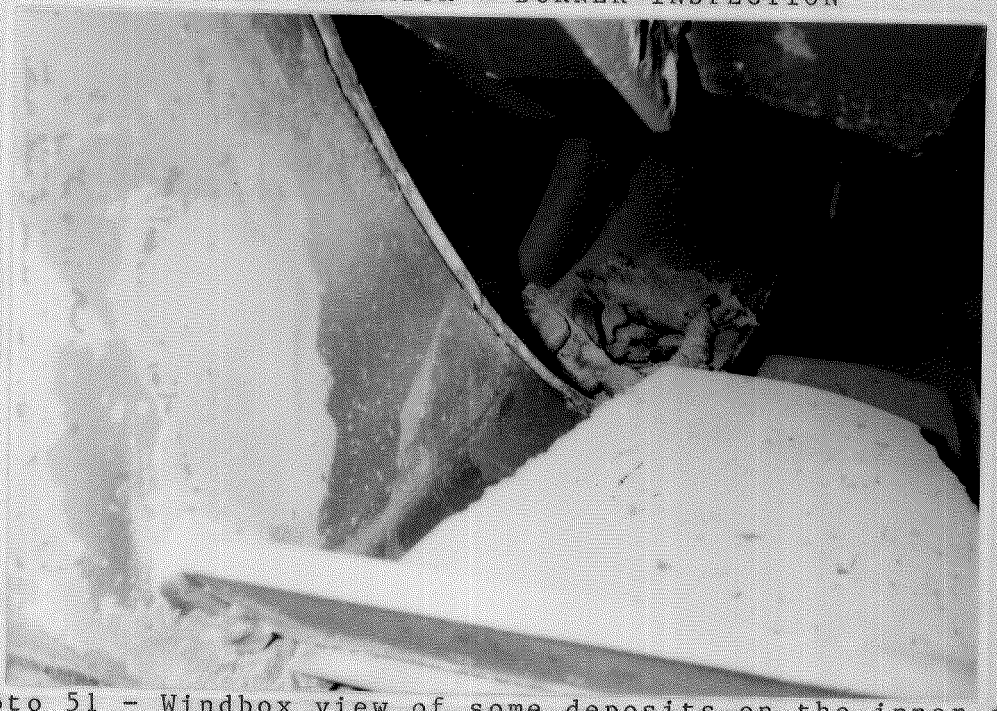

Photo 51 - Windbox view of some deposits on the inner air sleeve. Picture taken through outer air register assembly.

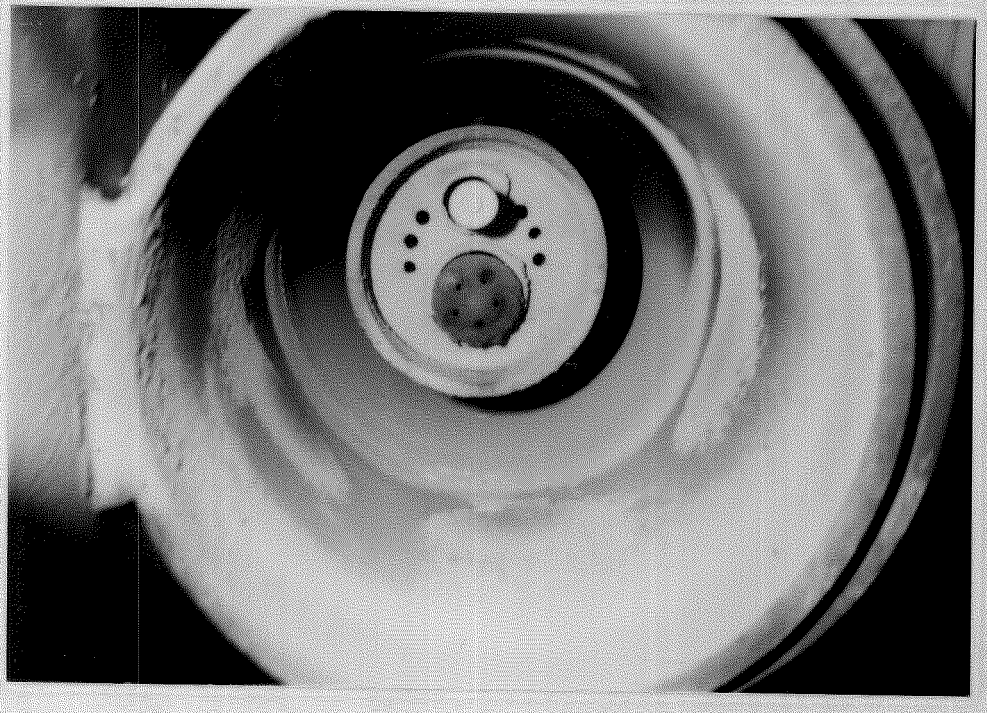

Photo 52 - Lighter assembly in dirty condition. Note fouled

STEAM GENERATOR - BURNER INSPECTION

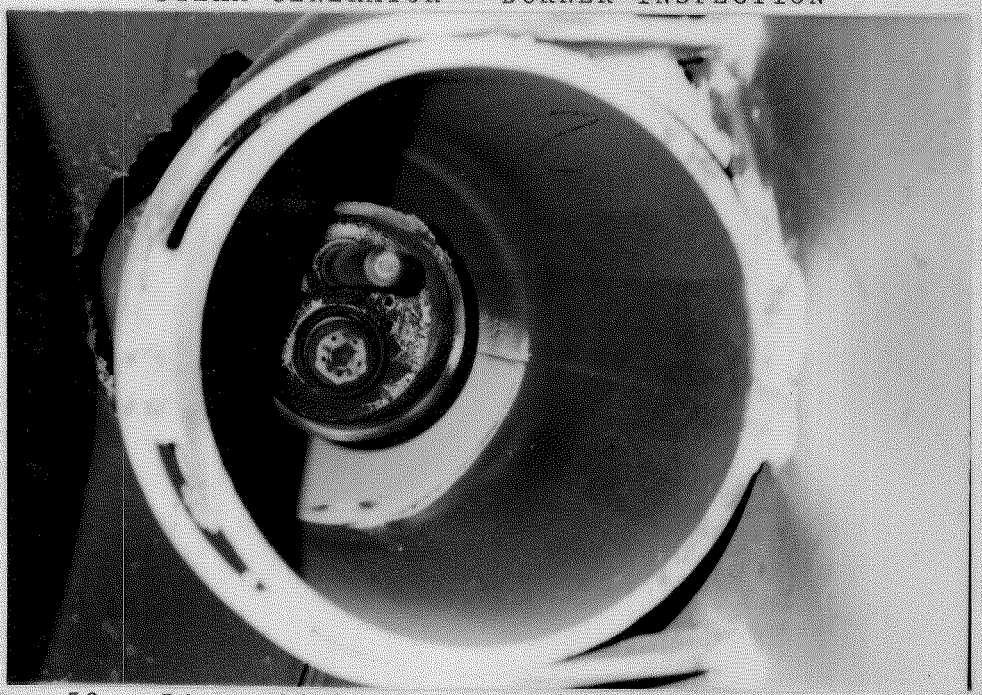

Photo 53 - Dirty lighter assembly that has been coked up possibly due to smoky flame.

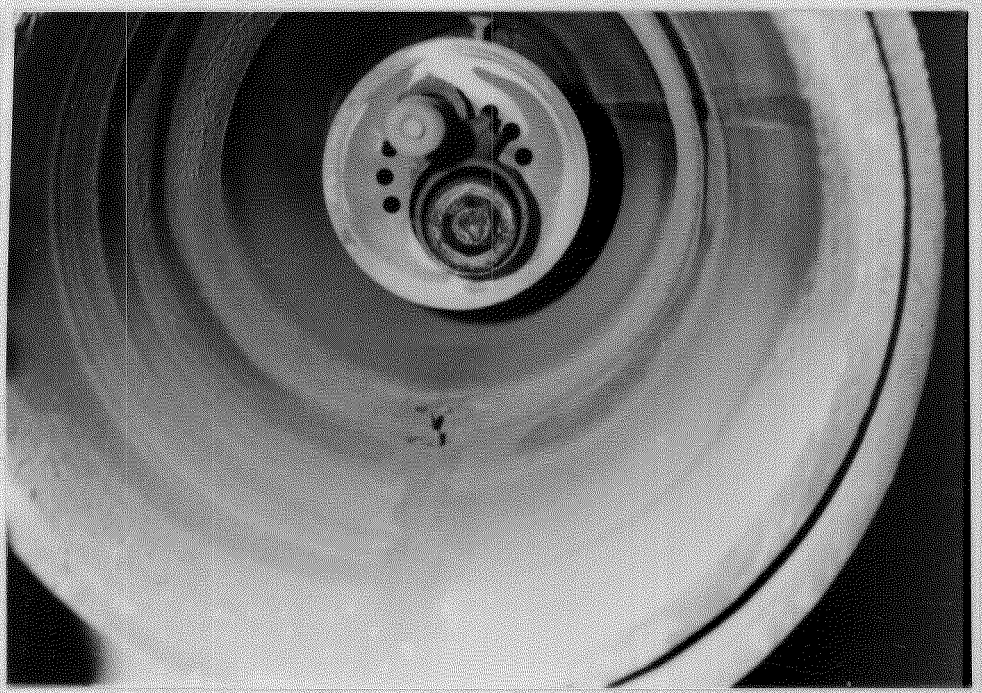

Photo 54 - Dirty lighter assembly with fouled sparker and lighter tips.

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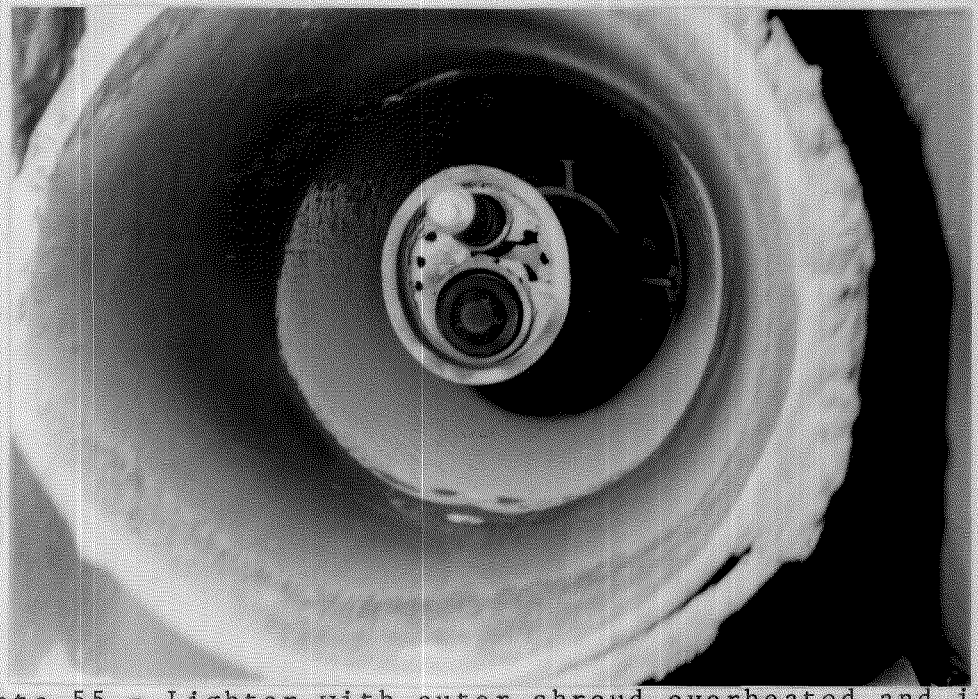

Photo 55 - Lighter with outer shroud overheated and in bell-out or barreled condition. This lighter assembly was replaced.

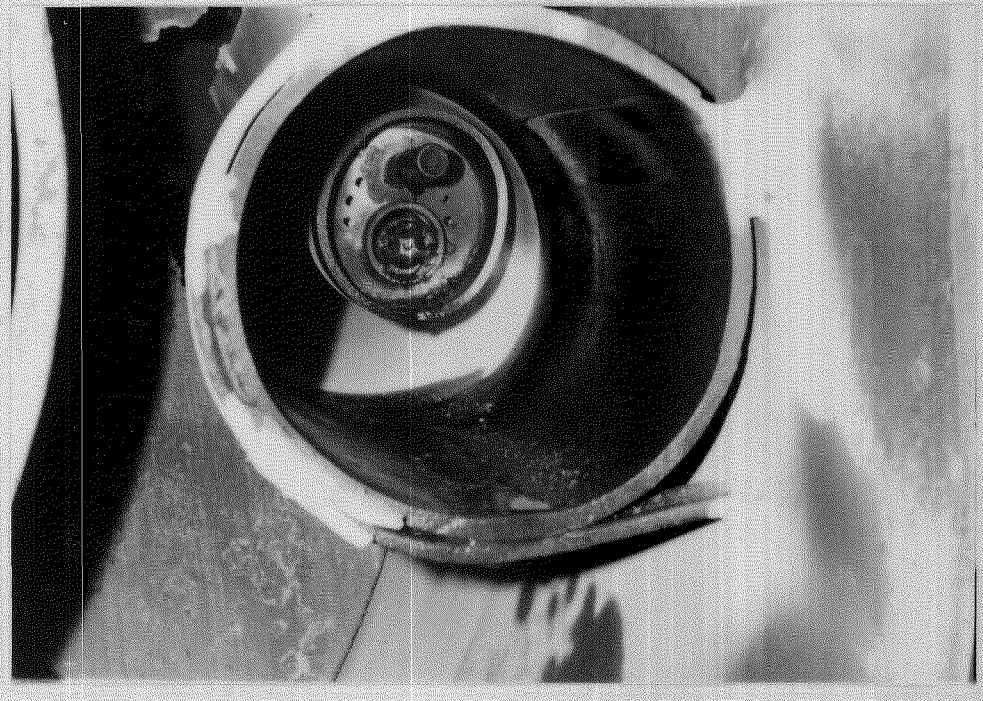

Photo 56 - Lighter with leaky fuel oil shutoff valve. This valve, plus six others, were repaired during the outage.

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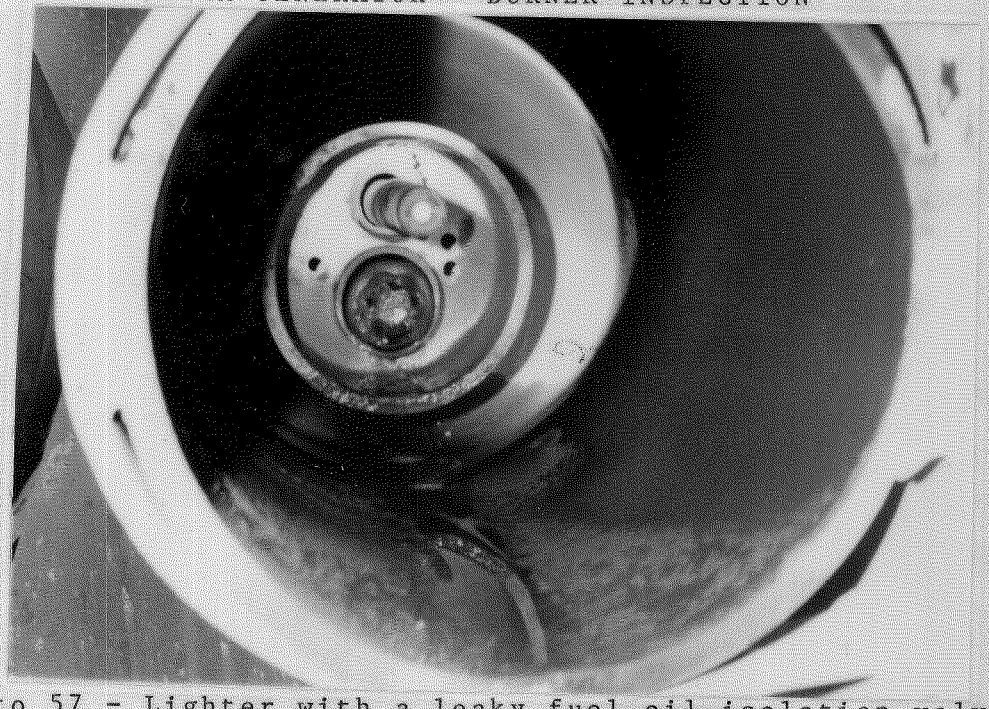

Photo 57 - Lighter with a leaky fuel oil isolation valve posing a fire potential in the lighter shroud.

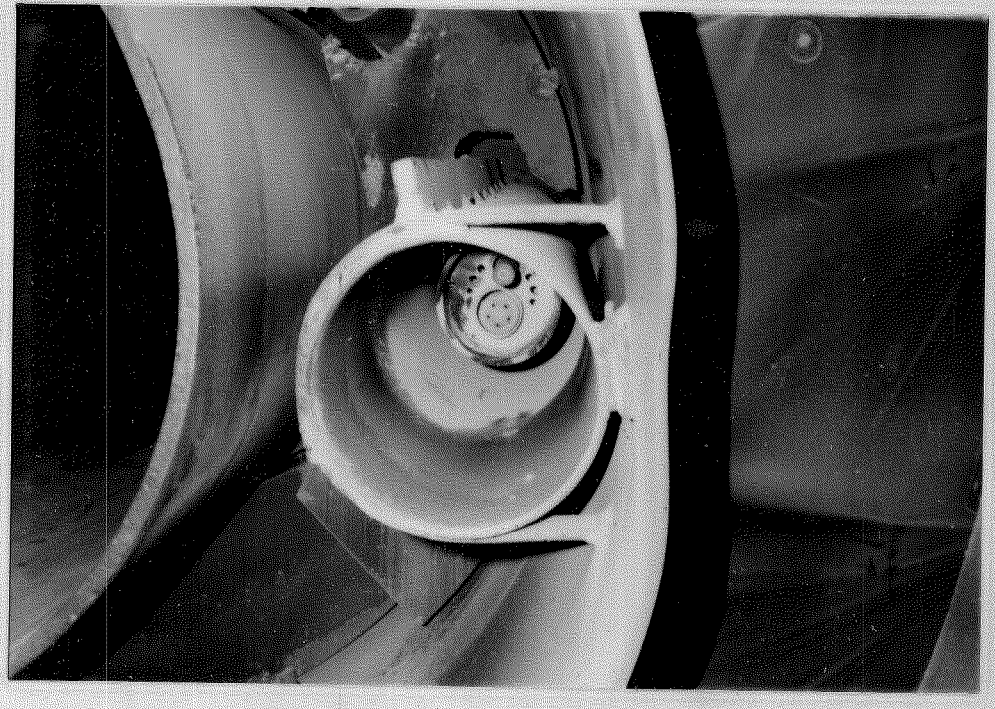

Photo 58 - Lighter shroud, which goes around the lighter assembly to prevent overheating, has caused warping to air sleeve due to an overheat condition.

STEAM GENERATOR - BURNER INSPECTION

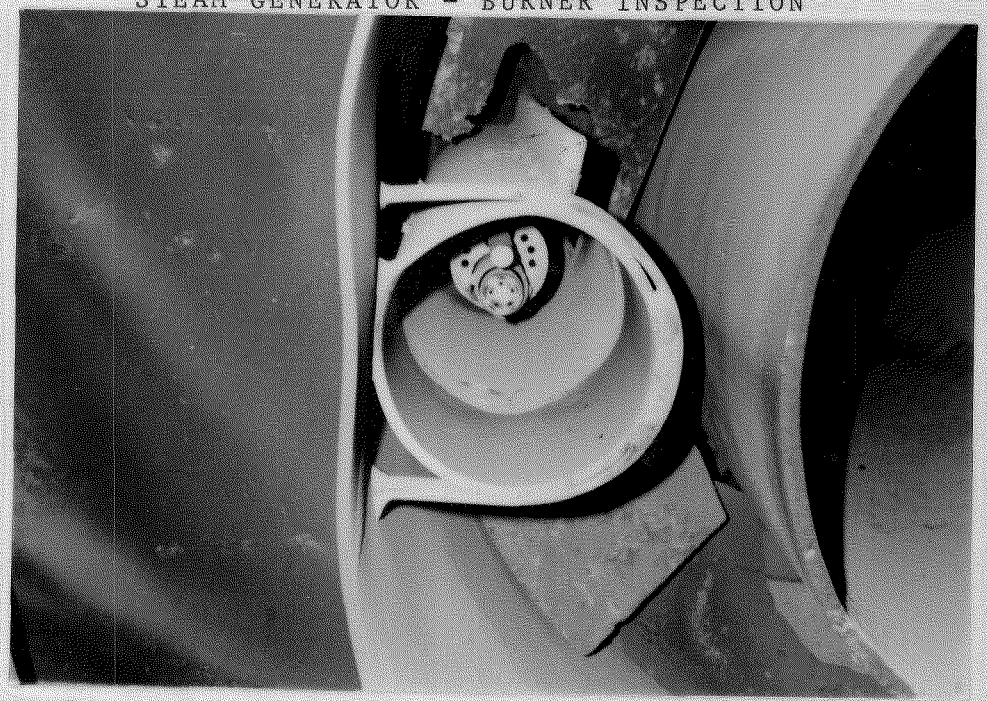

Photo 59 - Lighter shroud which has broken its U-strap attachment to the inner air sleeve due to overheat condition and warpage.

Photo 60 - Broken attachment weld on lighter shroud to inner air sleeve. This attachment which prevents the shroud from sliding horizontally and falling out.

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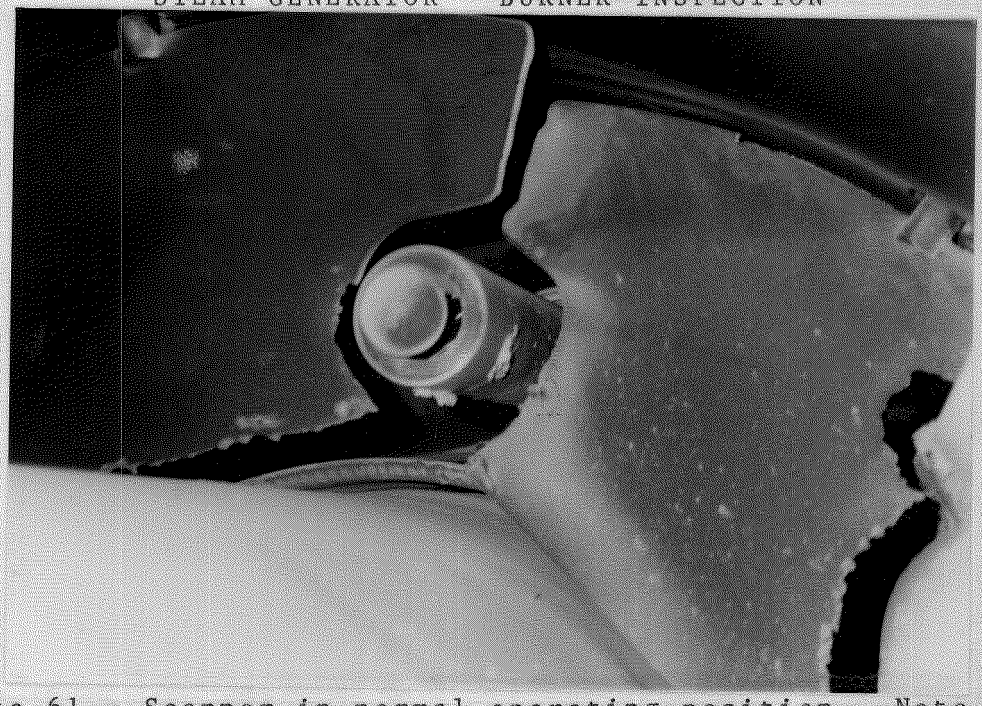

Photo 61 - Scanner in normal operating position. Note how far back from tip of coal nozzle scanner is located (thus realizing some of the difficulties when sighting in scanners for oil and coal flames).

Photo 62 - Scanner with buckshot damage occurring when eyebrows and slag are being shot from furnace waterwalls.

STEAM GENERATOR - BURNER INSPECTION

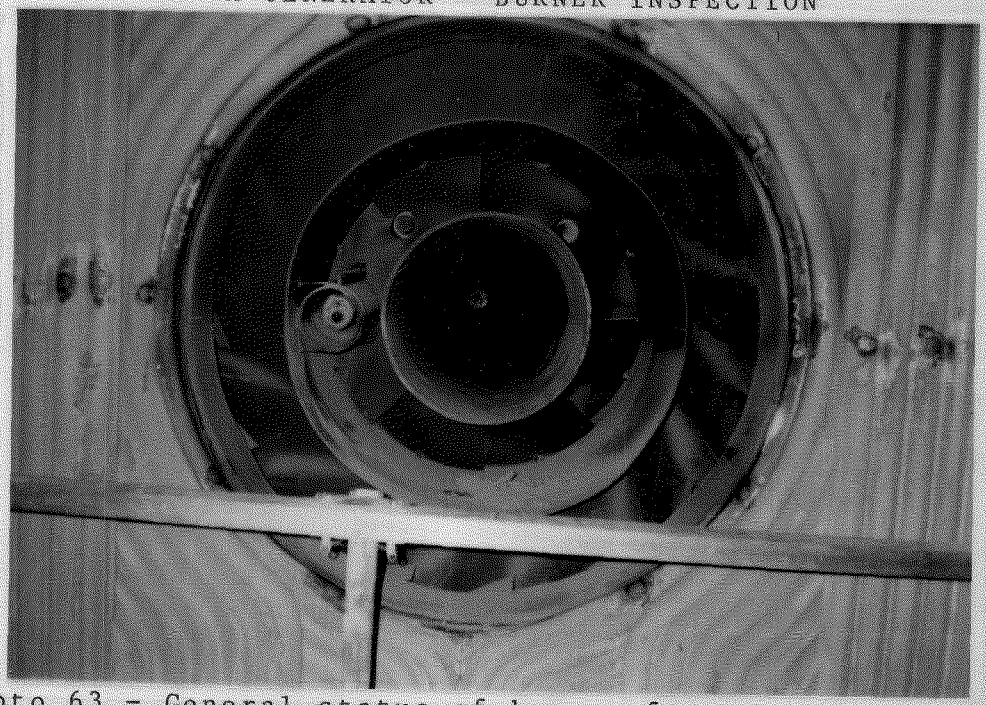

Photo 63 - General status of burner fronts, taken from boiler inspection platform.

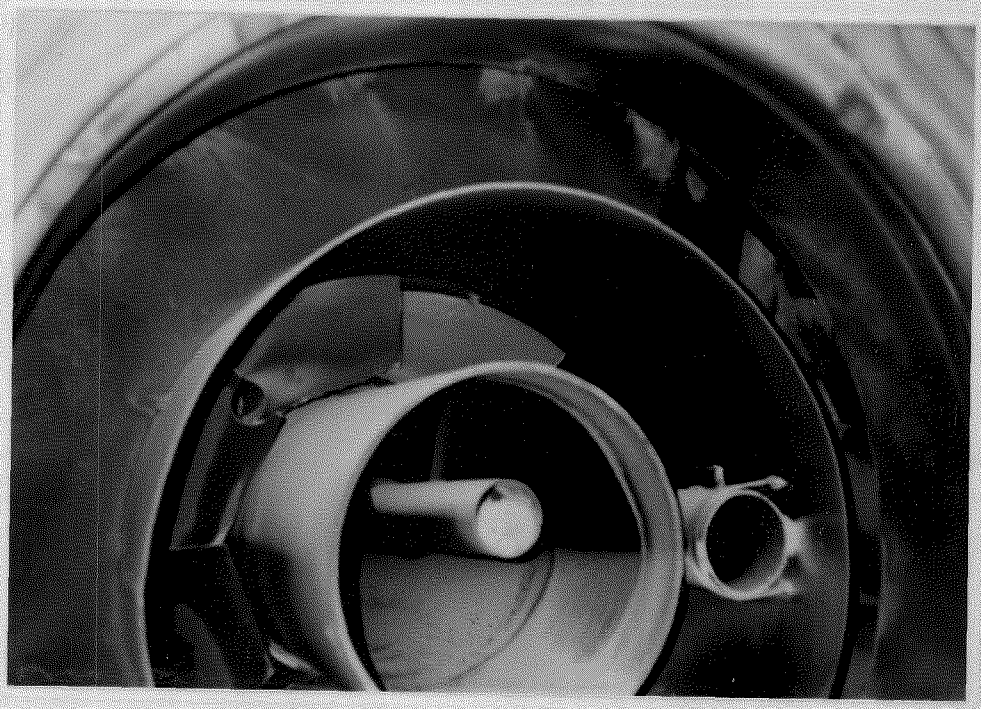

Photo 64 - Close-up angle of burner front showing general status and condition of burner.

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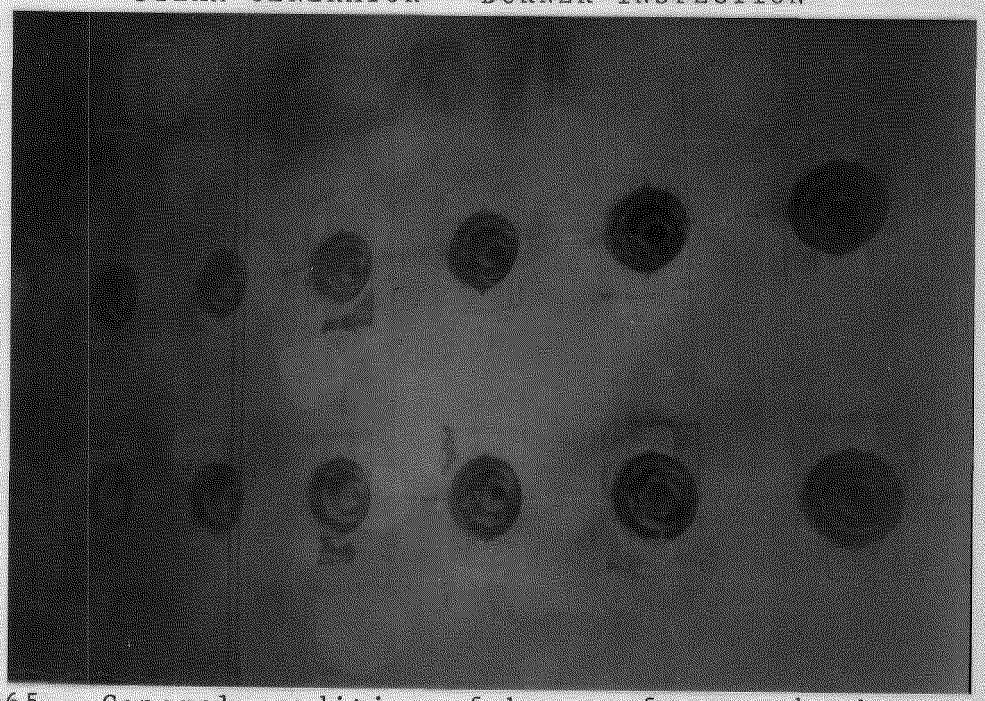


Photo 65 - General condition of burner fronts showing two of the four rows, six across the furnace front.

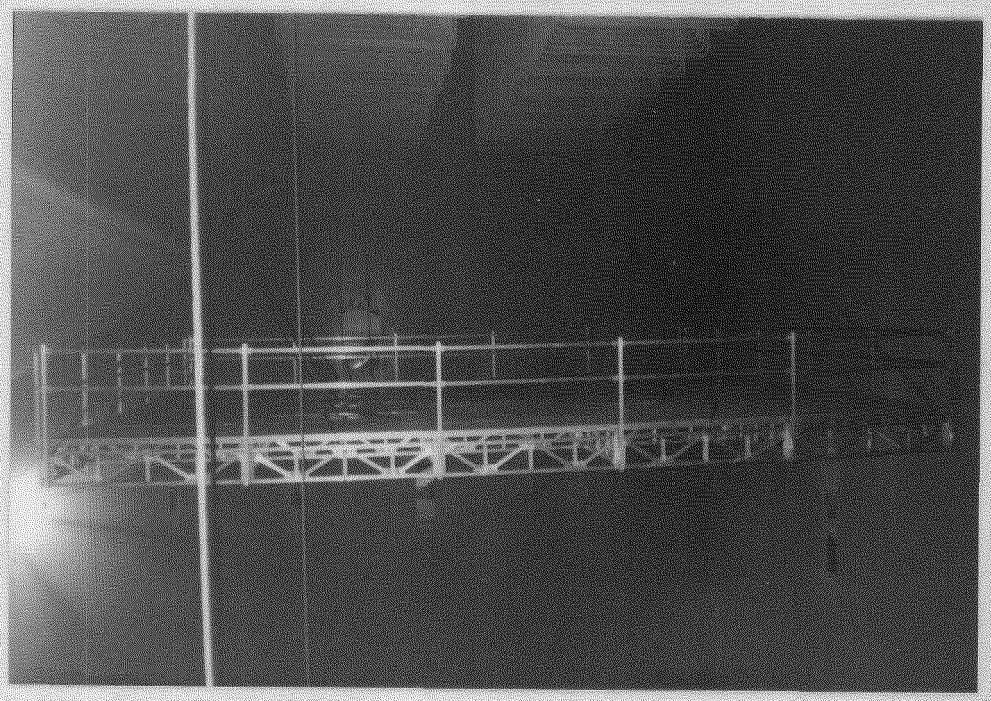
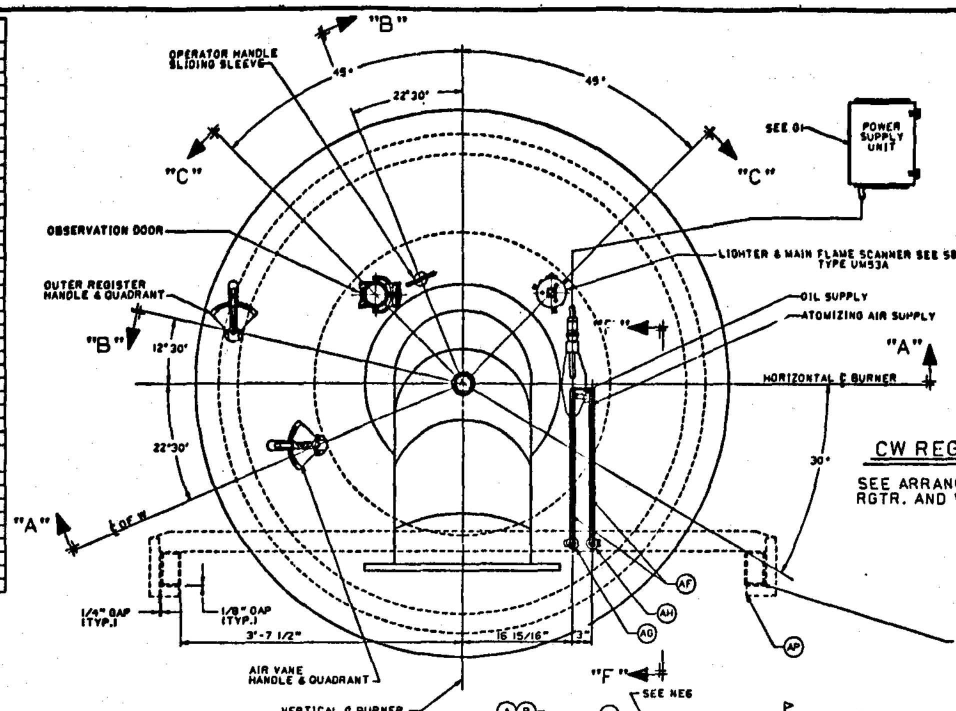


Photo 66 - Large boiler platform used for fireside burner inspections on the front wall of the furnace.

REFERENCE LIST: (36 DUAL REGISTER BURNERS 18 FRONT WALL, 18 REAR WALL)

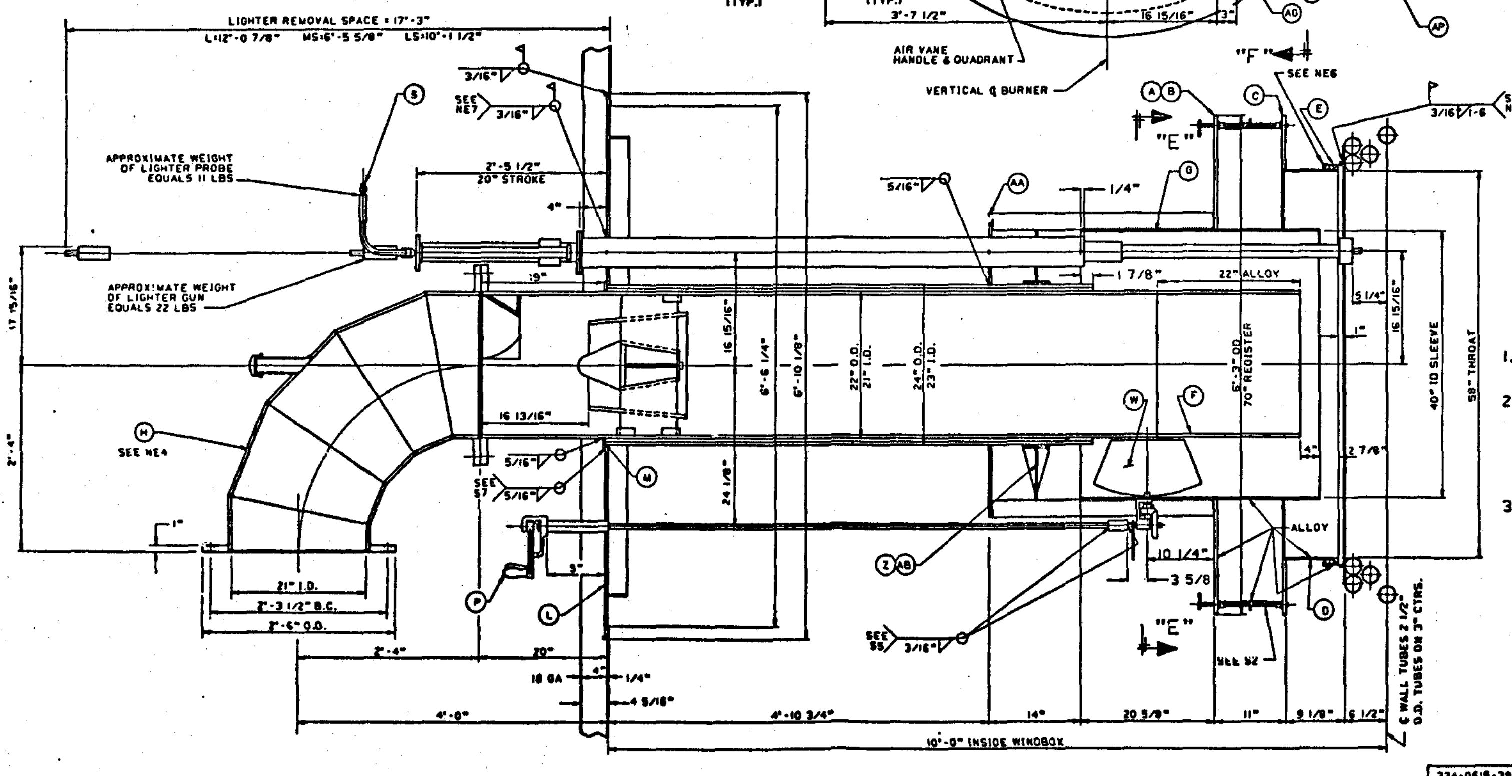
SYM.	DESCRIPTION	DWG.-NO.	MK-NO	RB-614 QTY.	RB-615/617 QTY.
A	INNER SLIDING SLV 70" OUTER RGTR ASSY 6 CW 6 CCW	157155D	1 & 2	18CW 18CCW	24CW 24CCW
B	OUTER REGISTER FRAME CUT-OUT REAR PLATE (196988C)	179890B	1 & 2	36	48
C	OUTER REGISTER FRAME CUT-OUT FRONT PLATE (196988C)	179891B	1 & 2	36	48
D	THROAT SLEEVE	196990C	2	36	48
E	THROAT SLEEVE CASING	173634B	9	36	48
F	21" DIFFUSER COAL NOZZLE ASSY "X"= 10'-5 5/8"	186463C		36	48
G	INNER AIR SLEEVE	173695B	1	36	48
H	21" SEGMENTED COAL ELBOW ASSY	199591C	1	36	48
J					
K					
L	COVER PLATE	199599C	1 & 2	36	48
M	MOUNTING PLATE	167660B	1	36	48
N					
P	HANDLE & QUADRANT ASSY. (VANE) "L"= 7'-9 1/8"	183366C		36	48
Q	OPERATOR HANDLE ASSY (SLIDING SLV) "L"= 7'-10 1/4"	188477C		36	48
R	HANDLE & QUADRANT ASSY. (OUTER REGISTER) "L"= 8'-6 3/8"	183357C		36	48
S	OIL LIGHTER CFA 18 RH. 18 LH.	269375E	1 & 2	18RH 18LH	24RH 24LH
T	OBSERVATION DOOR ASSY.	203788C		36	48
U	SCANNER SUPPORT ASSY. "L"=6'-10"	100150A	-	36	48
V	REGISTER SUPPORT BRACKET	179491B	1,2&3	108	144
W	AIR VANE	145450	26	36	48
X	AIR VANE ALTERATION	179889B		180	240
Y	THREADED BAR (AIR VANE LINKAGE)	133995A		36	48
Z	INNER AIR ZONE DISK	196998C	1	36	48
AA	INNER AIR SLEEVE CUT OUT FRONT PLATE (157155D SYM."N")	179893B	1 & 2	36	48
AB	INNER AIR ZONE DISK ALTERATION	179892B	1 & 2	36	48
AC	TEE SCRD. 1/2" 3000# SA105 3008/5362			72	96
AD	PLUG SCRD. 1/2" SQ. HD. 3000# SA105 5000/5362			72	96
AE					
AF	SUPPLY HOSE 3/8" ANACONDA BW21-1 X 57" LG. WITH GALVANIZED STEEL INTERLOCKED CONDUIT W/STYLE SHMW BOTH ENDS C.S. FITTINGS.			72	96
AG	VALVE BALL SCRD 1/2" WORCESTER 5846R-SE 600#			36	48
AH	VALVE GLOBE SCRD 1/2" VOGT 12443			36	48
AJ					
AK	NIP. TBE 4032/5361 SA106B 1/2" SCH. 080 X 3" LG.			144	192
AL	PIPE A120 3" SCH 040 X 6'-10" TOE NPT			36	48
AM	BUSHING SCRD 1/2" X 3/8" SA105 2916/5362			72	96
AN	UNION SCRD 1/2" 3000# SA105 2836/5362			72	96
AP	REGISTER SUPPORT BRACKET RETAINER	135865A	1	144	192
AQ	PLUG SCRD 3/4" SQ.HD. 125#			36	48

EIGHT (8) SETS OF LIGHTER MAINTENANCE TOOLS - ONE (1) SET PER BNR ROW



CW REGISTER CW VANES SHOWN

SEE ARRANGEMENT DWGS. FOR DIRECTION OF RGTR. AND VANE AIR FLOW FOR ALL BURNERS



SECTION "A-A"

NOTES:

1. FOR LIST OF REFERENCE DRAWINGS & NOTES SEE DRAWING NO. 197002C.
2. QUANITIES INDICATED ARE FOR ONE (1) UNIT. EQUIPMENT TO BE IDENTICAL FOR ALL FOUR (4) UNITS, EXCEPT FOR PLASMA TORCH LIGHTERS WHICH ARE TO BE FURNISHED FOR THE LOWER BURNER LEVEL OF UNIT 1 ONLY. (B&W CONTRACT RB-614)
3. THIS DRAWING REPRESENTS THE UPPER THREE BNR. ELEVATIONS FRONT & REAR WALL

REVISIONS

NO.	DESCRIPTION	DATE	APPROVAL
1	CHGD QUAN. OF LTRS SYM "S". NOTE ON MAINTENANCE TOOLS & ATOMIZING STEAM TO AIR. INDICATED VIEW "F-F". ADDED CONTRACT NO'S & NOTES 2 & 3. ADDED TO CUST. NAME.	[illegible]	DLS/JJJ
2	CHGD DIM. 4'-2" TO 4'-0", 23" TO 20" & 20 15/16" TO 17 15/16". CHGD. "L" DIM. SYM "T" FROM 10'-9 3/8" TO 10'-6 3/8". CHGD COAL NOZZLE ALLOY TIP FROM 12" TO 22". CHGD DIM IN ZONE A-8 FROM 4'-2" TO 4'-0". ADDED PLASMA TORCH REMOVAL.	[illegible]	MAB SBC/JJJ
3	CHGD DESC SYMS "F,H,Q,R,AC,AD,AF, AG,AH,AL & AM". DEL SYMS "AE & AJ". ADDED SYMS "AN & AP". CHGD REG SUPPORT TO NEW DESIGN. REVERSED OIL & AIR HOSES. CHGD "L" DIM. "LS" DIM & LTR. REMOVAL SPACE DIM IN ZONE "D-7". CHGD DIM 3/16" TO 1/4" & 4 1/4" TO 4 9/16" IN ZONE "A-6". CHGD DIM 3 1/8" TO 3 5/8" IN ZONE "B-4".	[illegible]	DLS/LE
4	DELETED SYM "N". ADDED DWG NO.S TO SYMS "B,C,L,R,Z,AA & AB". ADDED SYMS "AK & AP". RELOCATED OUTER REGISTER HANDLE & QUADRANT.	[illegible]	DLS/LE
5	CHG'D NOTE 2 IN ZONE B-2. ADDED SCANNER TYPE IN ZONE E-2.	[illegible]	SBC/LE
6	CHGD. "MS" DIM. 6'-8 1/8" TO 6'-5 5/8" IN ZONE D-7. CHGD. DIM. 4 1/4" TO 4" IN ZONE C-6. CHGD. DIM. 1/2" TO 1/4" IN ZONE C-4.	[illegible]	SBC/LE

INTERMOUNTAIN POWER PROJECT
STEAM GENERATOR UNITS 1,2,3 & 4
PROJECT FILE 9255.62.3401
IPA CONTRACT 2010N

21-58T-40S-70R
INDOOR UNIT SUCTION FIRED

THIS IS A CAD DRAWING DO NOT REVISE MANUALLY

DRN. BY J.W. SABATINE
CHKD. BY J. JENNINGS
D.A.O.
D.A. OYLER

SECTIONAL ASSEMBLY
DUAL REGISTER
BURNER

BABCOCK & WILCOX

334-0615-39
334-0616-39
334-0617-39

RB-0614

5-10008

SCALE 1 1/2"=1'-0"

294359E 6

IP7_003185

BDS 1698-1

LONGHAND MEMORANDUM — BABCOCK & WILCOX

TO: PHIL TICE, IPSC

FROM: DAVE MARCUSO B&W SERVICE

CUST.: IPSC

FILE NO. OR REF.: RB-0615

SUBJ.: BURNER SETTINGS - UNIT 2

DATE: 11/29/88

ALL BURNERS (OUTER REGISTERS, SPIN VANES, BACK PLATES), HAVE BEEN RESET FOLLOWING THE FALL 1988 OVERHAUL.

- EXSPANSION JOINTS WERE INSTALLED ON THE OUTER REGISTER DRIVE HANDLES.
- BACKPLATES AND FRONT PLATES OF REGISTERS WERE CUT FREE AND EXSPANSION CLIPS WERE INSTALLED

THE BURNER SETTINGS ARE AS FOLLOWS:

OUTER REGISTERS - 6" (DOOR STIFFENER TO DOOR - ON A PERANDICULAR)
SPIN VANES - ~ 30° (WHERE 90° IS STRAIGHT THRU, 0° IS CLOSED)
BACK PLATES - 5", 4", 3", 3", 4", 5"

SPIN VANE, REGISTER, AND BACK PLATE HANDLES WERE REPAINTED AND REMARKED
ALL ADJUSTMENTS HAVE BEEN LOCKED IN PLACE

IF THERE ARE ANY QUESTIONS, PLEASE CONTACT B&W @ x5395

CC: AARON NISSEN
FT MCGINLEY JR

John Mahalish / Dave Marcuso 11/26-27 Sun Mon 88
-2 spin vanes jammed (working on)

IP7_003186

REFERENCE LIST	36 DUAL REGISTER BURNERS (18 FRONT WALL, 18 REAR WALL)			RB-614	RB-615/617
SYM.	DESCRIPTION	DWG.-NO.	LK-NO.	QTY.	QTY.
A	INNER SLIDING SLV 20" OUTER RGTR ASSY 8 CW 8 CCW	197155D	1 & 2	18CW 18CCW	24CW 24CCW
B	OUTER REGISTER FRAME CUT-OUT REAR PLATE (1969880C)	179890B	1 & 2	36	48
C	OUTER REGISTER FRAME CUT-OUT FRONT PLATE (1969880C)	179891B	1 & 2	36	48
D	THROAT SLEEVE	196990C	2	36	48
E	THROAT SLEEVE CASING	173634B	9	36	48
F	21" DIFFUSED COAL NOZZLE ASSY "L": 10'-9 5/8"	188493C		36	48
G	INNER AIR SLEEVE	173695B	1	36	48
H	21" SEGMENTED COAL ELBOW ASSY	199591C	1	36	48
J					
K					
L	COVER PLATE	199599C	1 & 2	36	48
M	MOUNTING PLATE	167660B	1	36	48
N					
P	HANDLE & QUADRANT ASSY. (VANE) "L": 7'-9 1/8"	183366C		36	48
Q	OPERATOR HANDLE ASSY (SLIDING SLV) "L": 7'-10 1/4"	188477C		36	48
R	HANDLE & QUADRANT ASSY. (OUTER REGISTER) "L": 8'-6 3/8"	183357C		36	48
S	OIL LIGHTER CFA 18 RH, 18 LH.	269375E	1 & 2	18RH 18LH	24RH 24LH
T	OBSERVATION DOOR ASSY.	293788C		36	48
U	SCANNER SUPPORT ASSY. "L": 6'-10"	104150A	-	36	48
V	REGISTER SUPPORT BRACKET	179491B	1,2&3	108	144
W	AIR VANE	145450	28	36	48
X	AIR VANE ALTERATION	179889B		180	240
Y	THREADED BAR (AIR VANE LINKAGE)	133995A		36	48
Z	INNER AIR ZONE DISK	196998C	1	36	48
AA	INNER AIR SLEEVE CUT OUT FRONT PLATE (1971550 SYM. "A")	179893B	1 & 2	36	48
AB	INNER AIR ZONE DISK ALTERATION	179892B	1 & 2	36	48
AC	TEE SCRD. 1/2" 3000# SA105 3008/5362			72	96
AD	PLUG SCRD. 1/2" SQ. HD. 3000# SA105 5000/5362			72	96
AE					
AF	SUPPLY HOSE 3/8" ANACONDA BW21-1 X 57" LG. WITH GALVANIZED STEEL INTERLOCKED CONDUIT W/STYLE SHMW BOTH ENDS C.S. FITTINGS.			72	96
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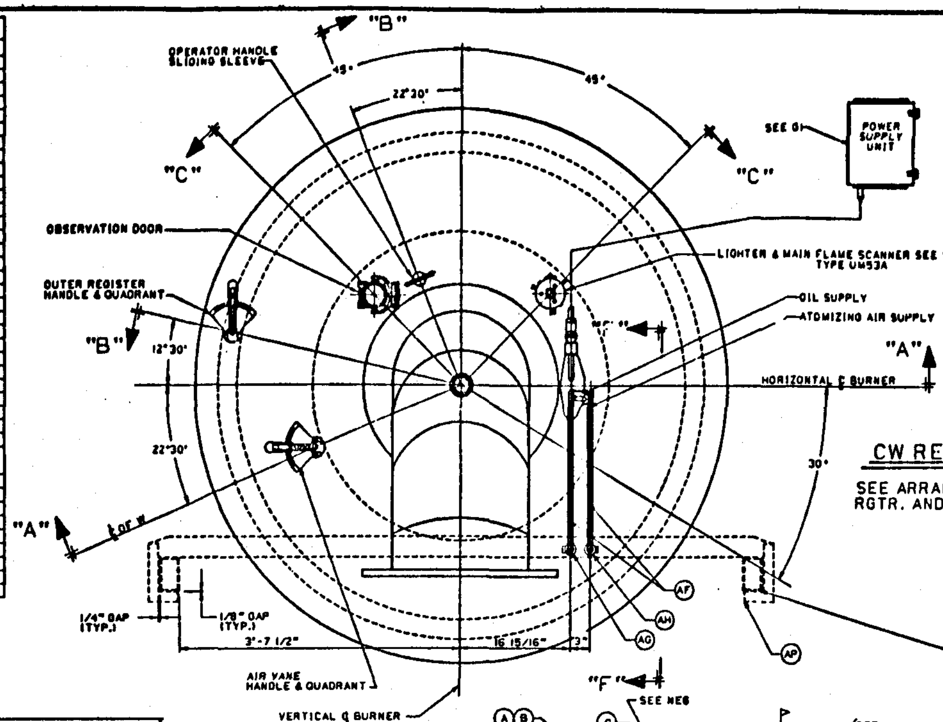
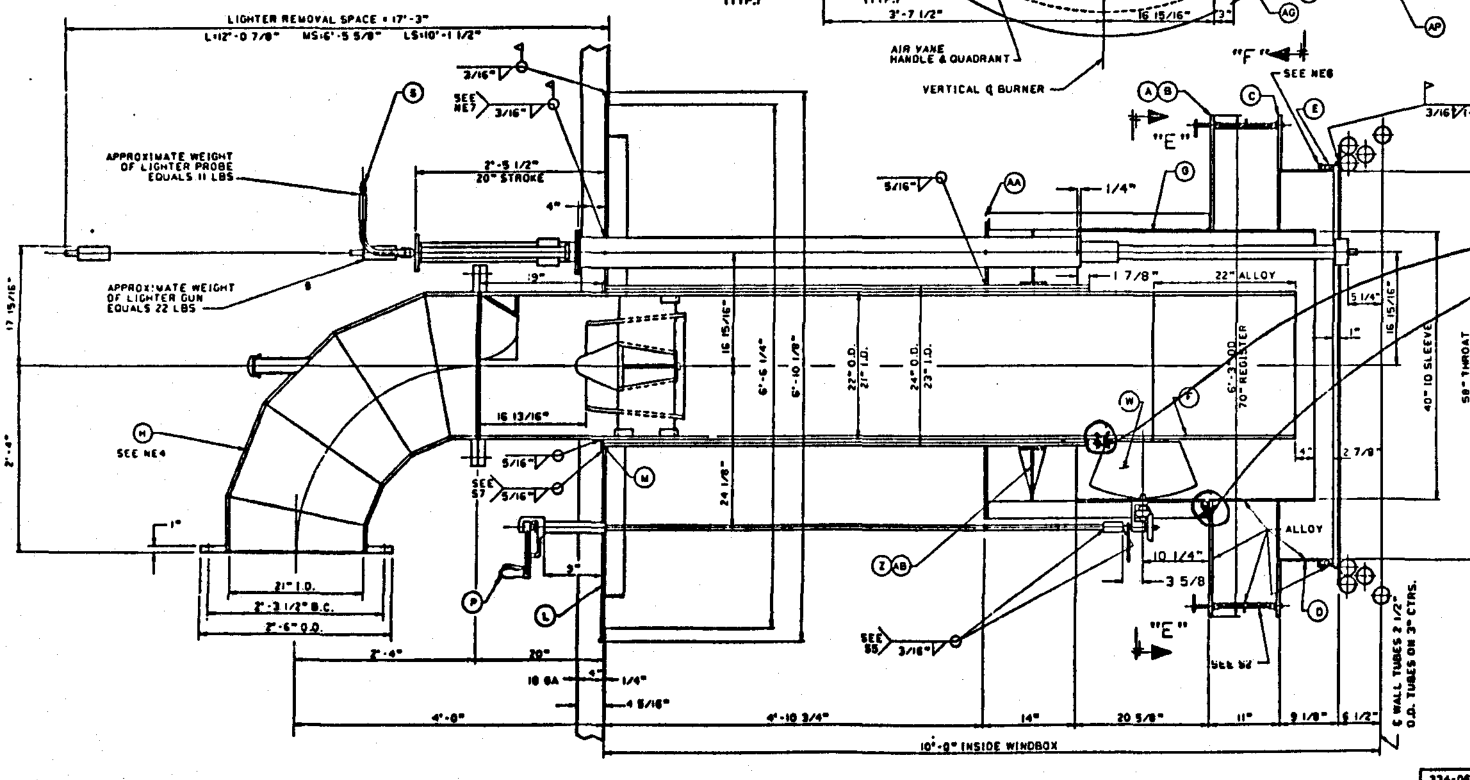
AQ	PLUG SCRD 3/4" SQ HD 125#			36	48

EIGHT (8) SETS OF LIGHTER MAINTENANCE TOOLS - ONE (1) SET PER BNR ROW



CW REGISTER CW VANES SHOWN

SEE ARRANGEMENT DWGS. FOR DIRECTION OF RGTR. AND VANE AIR FLOW FOR ALL BURNERS



T/C location:
1) bottomside burner nozzle
2) back-bottom outer register backplate

SECTION "A-A"

5-10008

NOTES:

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REVISIONS			
1	CHGD QUAN. OF LTRS SYM "S". NOTE 8 MAINTENANCE TOOLS & ATOMIZING STEAM TO AIR INDICATED ... ADDED CONTRACT NO'S & NOTES 2 & 3 ADDED TO CUST. NAME.	[illegible]	DLS/JJJ
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5	CHG'D NOTE 3 IN ZONE B-7. ADDED SCANNER TYPE IN ZONE E-2.	[illegible]	SBC/LE
6	CHGD. "H2" DIM. 6'-8 1/8" TO 6'-5 5/8" IN ZONE D-7. CHGD. DIM. 4 1/4" TO 4" IN ZONE C-6. CHGD. DIM. 1/2" TO 1/4" IN ZONE C-4.	[illegible]	SBC/LE

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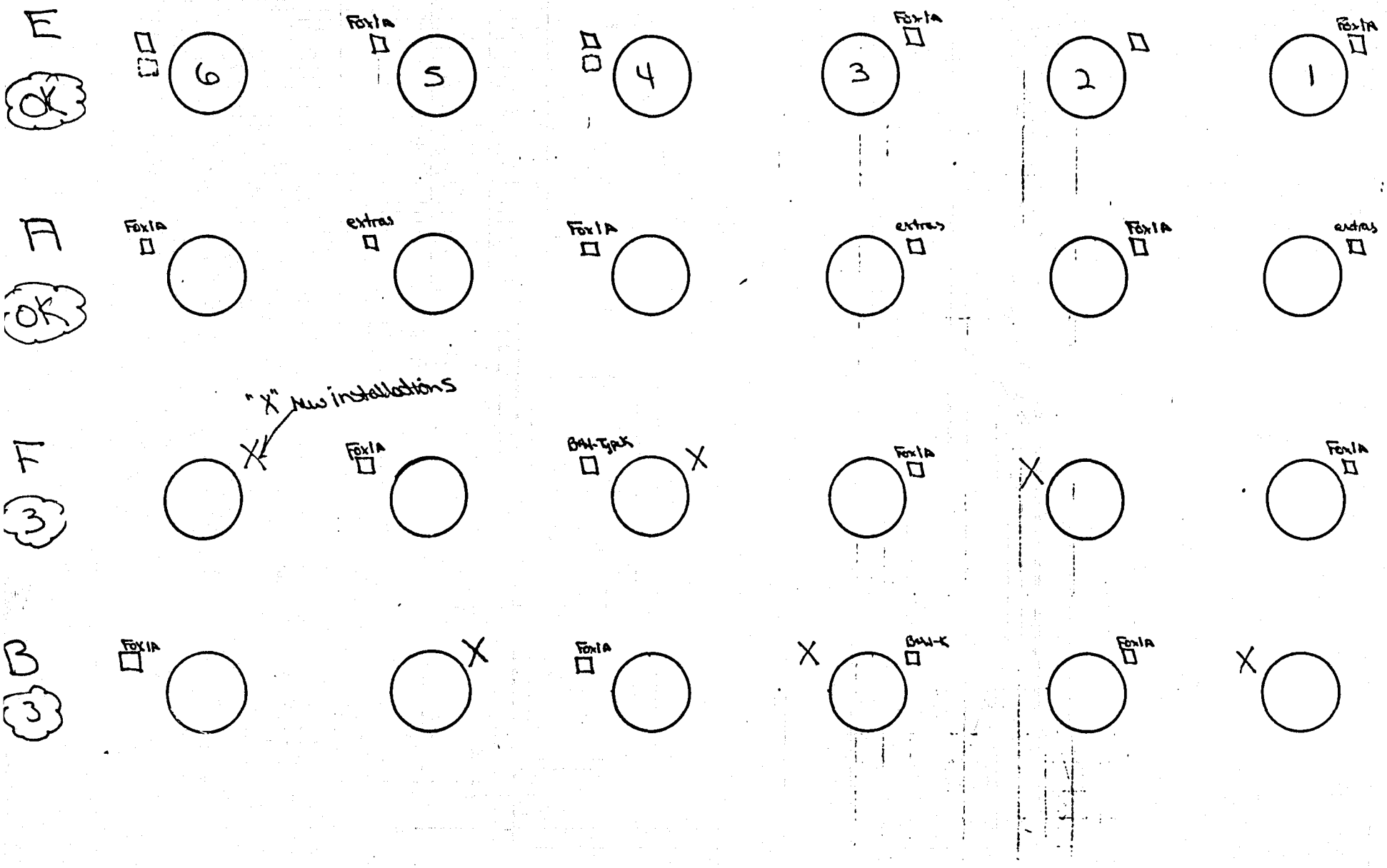
DRN BY J. M. SABATINE	SECTIONAL ASSEMBLY DUAL REGISTER BURNER	BABCOCK & WILCOX	
CHKD BY J. JENNINGS			
D. A. O.			
D. A. OYLER			
334-0619-39	RB-0614		
334-0618-39			
334-0617-39			294359E 6

IP7_003187

BURNER ARRANGEMENTS:

FRONT WALL



BURNER ARRANGEMENTS: